CIVIL ENGINEERING

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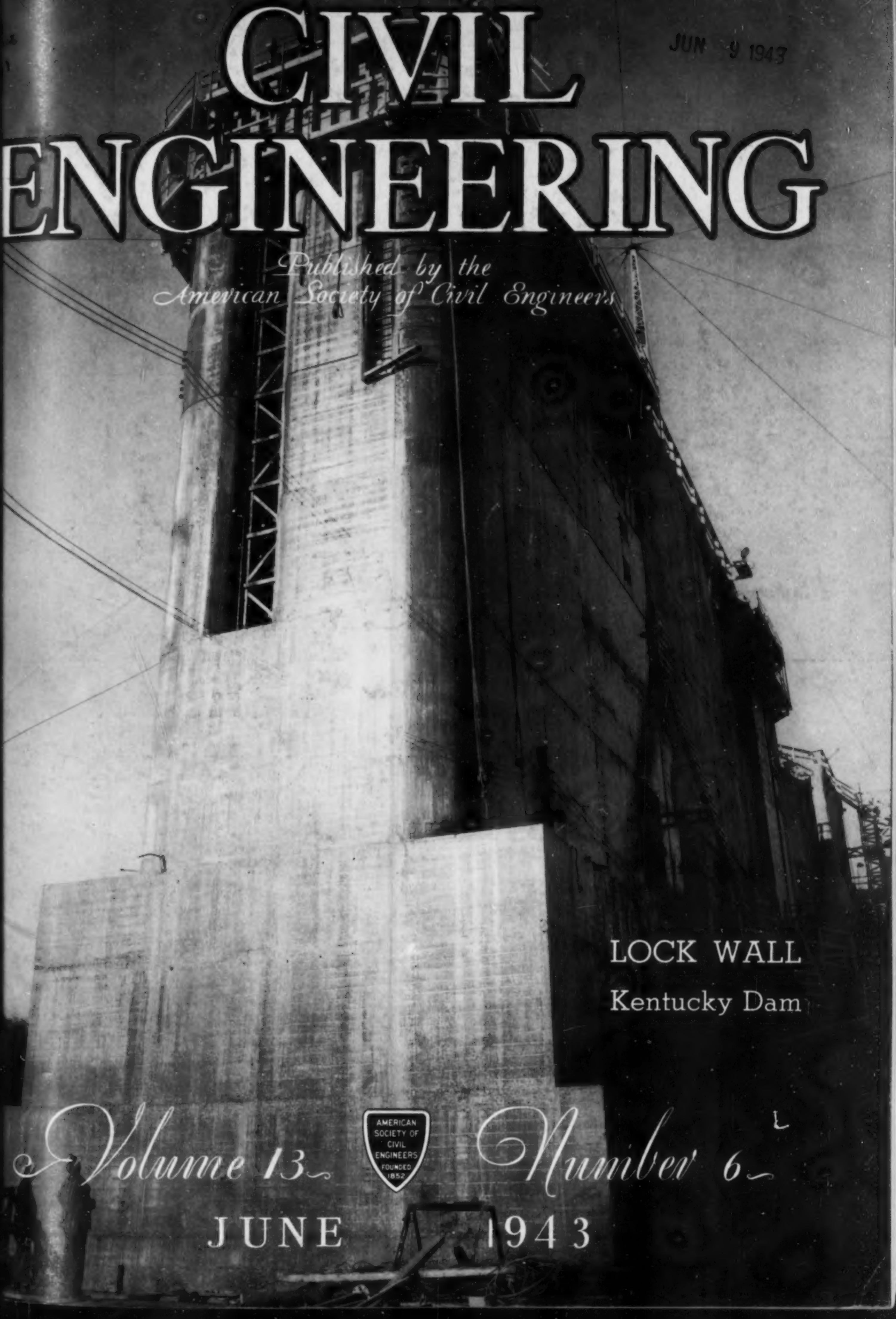

LOCK WALL
Kentucky Dam

Volume 13 Number 6
JUNE 1943

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

can afford to be economical with essential steel

We are lucky that America can, without serious detriment to any phase of the war effort, use steel . . . and produce the steel to use . . . for every indispensable war weapon, material or war production facility that cannot be suitably or safely made of other materials. ● This does not mean that steel is a drug on the market, or that substitutes are not being sought for many purposes, or that these substitutes should not be used when found suitable. ● But it does mean that, when no suitable substitute has been found, America need not attempt to do without steel where steel is necessary. For to do without necessary steel when steel is available, or to use an unsuitable substitute, would be uneconomical and frequently unsafe. In other words, America can afford to be economical with essential steel for essential purposes . . . whether it be for guns and tanks, buildings and their concrete pile supports, or machine tools or bayonets . . . just so long as the requirements are reasonable and the war effort is truly served.

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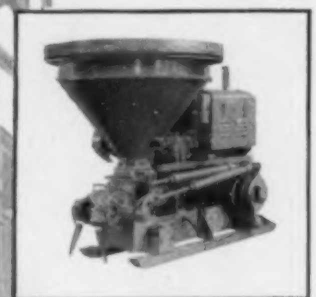

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

On the Meaning of "Professional"

Adapted from the "Tennessee Engineer," Organ of the Tennessee Valley Section

By N. W. Dougherty

Member American Society of Civil Engineers

Dean of Engineering, University of Tennessee, Knoxville, Tenn.

Many words have meanings that depend upon the context and often upon the tone of the voice. "Professional" is one such word. It may be used to describe a golfer, a tennis player, an opponent's football player, a racketeer, or a charity worker. Its meaning is determined by its use. When applied to a vocation it is often modified by the adjective "learned" to make the designation "learned profession."

Not Exclusive to Engineers.~Engineering is a learned profession and as such it has certain characteristics which set its practitioners apart from the great non-professional group. Here the implication of the word is not the same as when used to describe a baseball player or a wrestler.

What then are the characteristics of a professional man? It is obvious that many of them are common to the uninitiated as well as to the initiated. All good citizens have a social duty and most of them are actuated, in part at least, by a service motive. For professional men these aims assume a texture not found in ordinary daily actions. They are duties imposed by leadership and special knowledge, which require dedication and devotion to a cause rather than moral support. Again, all civic bodies have standards of admission and rules of conduct. The distinction, if any, must come in the quality of admission standards and the excellence of conduct.

Let us examine a little more closely the meaning that should be attached to the several professional essentials. First come the general attributes.

High Intellectual Plane.~Is it just talk or does the practice of engineering require intellectuality? By all the tests of intellectual capacity engineering students in the schools have a very high rating. The body of knowledge has all the marks of involving intellectual activity. It is scientific in the extreme, it is mathematical, it is logical, it is experimental, it embodies economic principles, and it requires a knowledge of the forces and materials that make up our industrial life.

The study of engineering requires an agile mind which is discerning and acute and capable of sustained effort. If a way could be developed to measure mental effort, the effort expended by students of engineering subjects would weigh heavily on the scales.

Service Motive.~Milton has said: "They also serve who only stand and wait." This is not the type of service required of the professional man. It must be the over and above service. Wickenden has put it as the doctrine of "the second mile." Vannevar Bush has said that the engineer, and any professional man, is a direct descendant of the old medicine man whose place in the tribe was fixed "by his service to the people." It is more than rendering the service for which he is paid; it is rendering all the service that is needed.

A young man was in my office a few years ago on a vacation from Cuba after some two years of work. He told me he had another week on his vacation but he was going back the next day. "Why are you going back so soon?" I asked. "Because they need me down there." He had not studied the essentials of a profession but he was developing its attitude. "Need" was reason enough.

Individual Responsibility.~Professional men act as individuals. They act in groups and in companies, but their work is such that the responsibility for it must be taken by individuals. Even when a group or a company reaches a decision, some one in the group must sign the contract, the drawings, the specifications. Responsibility searches out an individual and comes to rest upon his shoulders.

Professional men give the orders that they themselves must obey. They write the rules of the game and then take the responsibility of living up to these rules. They must be the judges of their own professional acts; no other group in society can. This responsibility is far more than "carrying out orders"; it is making the orders and then seeing to it that the maker performs what his own best judgment says he should perform.

Social Responsibility.—All citizens owe responsibility to the community and the state. Professional men have a peculiar responsibility. Their acts affect the public weal. In any community the doctor and the lawyer are expected to assume positions of leadership. In the past they have lived up to this responsibility. Teachers in rural communities have more influence than almost any other citizens. They cannot escape leadership.

To engineers has been committed the protection of the public health and the public safety. They invent a device in the laboratory, and it transforms a civilization. Avoid it though they try, they cannot but be their brother's keeper.

Professional men are the privileged people of the community. They have had more formal training; they make more contacts with public life and institutions; they therefore owe a double duty to the community. Their legal right to practice the profession is guarded by the whole people, and he who is derelict in his public duty is failing to carry out an obligation that only he or his confreres can fulfill.

Fiduciary Relation.—The ancient medicine man stood in a confidential relationship to his fellow tribesmen. This ancient doctor and priest determined the cause of the trouble and prescribed the remedy. To keep his place in the tribe his judgments had to conform to the needs of his clientele. A patient goes to a physician for treatment not knowing his ailment or the remedy. He must depend upon the diagnosis of the physician and he must follow the treatment for recovery. A client goes to an attorney. He knows the wrong that should be righted but he may not know the plea to make or the court to address; he must depend upon his attorney for direction. In both cases the professional man must determine the procedure and then be responsible for the results.

The engineer often stands in a similar relationship to the client. The client does not know where to go or what material to use; he only knows the results he is seeking. More often, however, the engineer's responsibility is more to the general public. His employers have made decisions which require engineering talent to produce and perform. Always the work should be done in such a way that the public will be protected. If technology conspires with greed, the results will be sad indeed. The confidential relationship with the individual client may be absent on many jobs, but there is always a responsibility to the general public.

An Educational Process.—In addition to the general attributes just discussed, certain group attributes, such as education, are to be noted. By education is not meant trade practices and skill in the use of the tools of engineering, but rather an intelligently directed development of the mental faculties of the practitioner. It ends in knowledge of the technique of engineering but at the same time it develops a sound philosophy of life.

The necessity for formal training is not as apparent. By "formal" we do not necessarily mean a college course, although it is becoming increasingly that. We mean an organized effort to acquire the needed scientific background and the needed technology to practice with requisite knowledge and skill. Formerly many men achieved eminence in the field of engineering without college training, but they were good students, although self taught. Engineers cannot "pick up" enough knowledge to do their professional work. They must be students as well.

The student is not satisfied that an action takes place; he must know why. He develops his ability in making observations, his judgment in interpreting results, and withal he tries to express his findings in a language that can be understood by others. The shortest road to mediocrity in engineering is to quit studying and to read only for entertainment.

Standards of Admission.—Any organized group must have some initiation requirements to set it apart from the crowd. Formal recognition in the professions is accomplished in various ways. Public esteem is essential and recognition may be by public approval. Since the general public cannot distinguish between degrees of competence, professional recognition must come from the profession itself. Only members of the professions can pass upon the qualifications of their members.

After much discussion and some thought, engineers have fixed admission at graduation from a school of recognized standing and four years of satisfactory practice. This is required by the model license law and by the definition of the E.C.P.D. Grades of society membership vary somewhat, but full membership requires at least this or its stated equivalent—eight years of satisfactory practice plus examination, or twelve years of satisfactory practice ending in responsible charge of work.

Code of Conduct.—All men have the codes of conduct determined by the experience of their forefathers. In the professions there are peculiar relationships which develop between fellow practitioners, between employers and practitioners, and between practitioners and the public at large. All the professions have codes of conduct setting forth these relations as they should exist.

Beginning with Hippocrates and his oath and coming down to the committees of the national societies, professional men have developed codes of conduct and practice. To read and study them is to get a picture of the ideals and motives of the groups.

Group Consciousness.—Because of the heterogeneity of engineering practice, it has been difficult to develop a group consciousness. The range of activity is so wide in each field that it is difficult to find a common ground for action. To attain full professional status, a way must be found to enlist the interest of all engineering groups. There must be some common ground for action.

For many years engineers have tried to find an agency that will unify all fields of their activity. They have sought a spokesman for the profession. None of these efforts, to date, have been as successful as their promoters had hoped, although the Engineering Council for Professional Development now bids fair to become that unifying agency. To get common action we must work toward common objectives; and there are many such objectives for engineers as a whole. We must attack and solve, partially at least, the problem of economic status; we must find a spokesman for engineers at the bargaining table. There are other common grounds of activity which should unite us into one strong agency which will aid us in carrying our professional banner.

We civil engineers have gone a long way in building a profession. Let us join hands in a general movement to bring about the professional recognition which our activities deserve.

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Number 6

Heating Arch Ties for a Concrete Roof

Electric Ovens Utilized in Construction of Wharf Shed at St. John Harbor, Canada

By Frank E. Sterns, M. Am. Soc. C.E.
Engineer, National Harbors Board, Ottawa, Ontario, Canada

To reduce secondary bending stresses in the columns of a reinforced concrete transit shed, a method of heating tie bars for the roof arches during concreting was devised. The construction of this shed upon a wharf built several years ago required but slight revision of existing facilities. This paper, originally presented by Mr. Sterns before the construction Division at the Society's joint meeting with the Engineering Institute of Canada in Niagara Falls, Ontario, is here brought up to date.

The harbor of Saint John, New Brunswick, is an important unit in the transportation system of Canada, being one of the few large harbors on the eastern seaboard which is open throughout the winter. Its development has been assisted by the Canadian Government from time to time since confederation, and it was established as a national harbor in 1927. Upon the creation of the National Harbors Board in 1936, it came under the jurisdiction of that Board.

In June 1931, fire swept the west side of the harbor. All the transit sheds and other buildings on the wharves were destroyed and all the wharves, with the exception of the concrete wharf at the south end of the area, were burned down to mean water level. Reconstruction was commenced at once except at three berths where the complete removal of the old timber cribwork was necessary. Funds for this work were not available until 1934.

These newer wharves consist of a concrete deck structure 17 to 18 ft in depth, supported partly on cylindrical concrete caissons 9 ft in diameter sunk to rock, and partly on timber bearing piles cut off near mean water level, Fig. 1. A full description of the wharf construction was given in a paper by V. S. Chesnut (*Engineering Journal* of the Engineering Institute of Canada, October 1936).

The wharves were built with the intention of placing transit sheds on them when required to meet the demands of traffic. The type of shed contemplated had a single story and a structural steel frame with columns along the front and rear walls and roof trusses spanning the entire width.

Placing First Concrete Caisson for the Wharf
These 9-Ft Caissons Were Filled with Concrete After Placement

Two sheds of this type were constructed in 1937 and 1938. The remaining berth was used for cargo that did not need protection from the weather, but it later became necessary to proceed at once with the construction of the third shed. Along the west half of this berth, the railway track serving the wharf curves sharply away from it, and a triangular loading platform some 20,000 sq ft in area extends from the wharf deck to the track. The annex over the loading platform forms a major feature of the shed.

Application to the Steel Controller revealed that structural steel for a frame could not be made available but that sufficient bar steel for the reinforcement of a concrete structure could be released. The relative advantages of reinforced concrete and timber were therefore investigated. A preliminary design and cost estimate indicated that the use of timber instead of reinforced concrete would reduce the cost of the shed by only a few thousand dollars. In view of the greater fire hazard and the probable shorter life of a timber structure, a frame of reinforced concrete was considered preferable.

For reinforced concrete structures of this kind, bents of the rigid-frame type have frequently been found suitable. But for this shed, as it is to be built on an existing reinforced concrete deck, serious difficulty would be

INTERIOR VIEW OF SHED SHOWING REINFORCED CONCRETE ARCHES

ON TRACK SIDE OF SHED, SLIDING DOORS GIVE READY ACCESS

met in installing the necessary tie rods between the feet of the columns, as they would have to be placed under the deck slab of the wharf and be brought up through it at a small angle to be connected to the columns. Using bents consisting of tied arches supported on columns, the ties could be placed overhead and these difficulties avoided. As rough estimates based on preliminary designs indicated that the cost of frames of these two types would be nearly the same, the tied arch type (Fig. 2) was considered preferable. For the annex, a frame of columns, girders, and beams was used.

As the dead load of a shed having a reinforced concrete frame would be considerably greater than that of the steel-framed type contemplated when the wharf was built, the stresses in the wharf structure under the heavier column reactions were carefully investigated. In general, the wharf was found to be well able to carry the additional loads, but some reinforcement at one rear column was considered advisable.

A 3-in. laminated or mill-type timber roof was adopted, with built-up tar and gravel roofing guaranteed for 20 years. The structure was designed for a snow load of 30 lb per sq ft and a wind load of 30 lb per sq ft, the wind stress in any member being reduced by one-third of the sum of the dead and live-load stresses in the member; also for loads of 122,000 lb at the front column and 33,000 lb at the quarter point of each arch from a grain conveyor gallery which may be built later above the shed roof.

Working stresses in concrete and reinforcing steel were those recommended by the Joint Committee. Concrete having an ultimate compressive stress of 4,000 lb per sq in. at 28 days was specified. The tie rods of the arches, which had to be specially rolled to get the length of 92 ft 6 in. required, are of structural grade steel, but all other reinforcing bars are of rail steel. To guard against corrosion under exposure to the moist sea air, the steel was protected by a covering of concrete at least 2 in. thick. This also affords adequate fire protection.

The arch, shown in Fig. 2, has a span of 91 ft $2^1/_2$ in. and a rise of 10 ft. Its width is 19 in. and its depth, over the rear half of the span, is 33 in. The outlines of the front half of the arch are smooth curves chosen to give the required increase in depth to 42 in. at the quarter point, where the gallery load will be applied, and to present a smoothly tapering appearance.

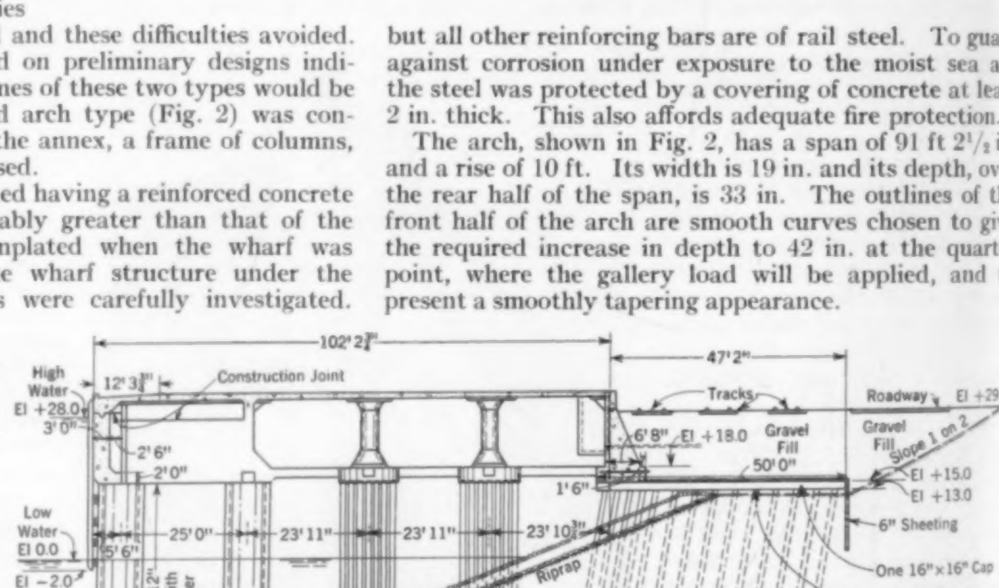
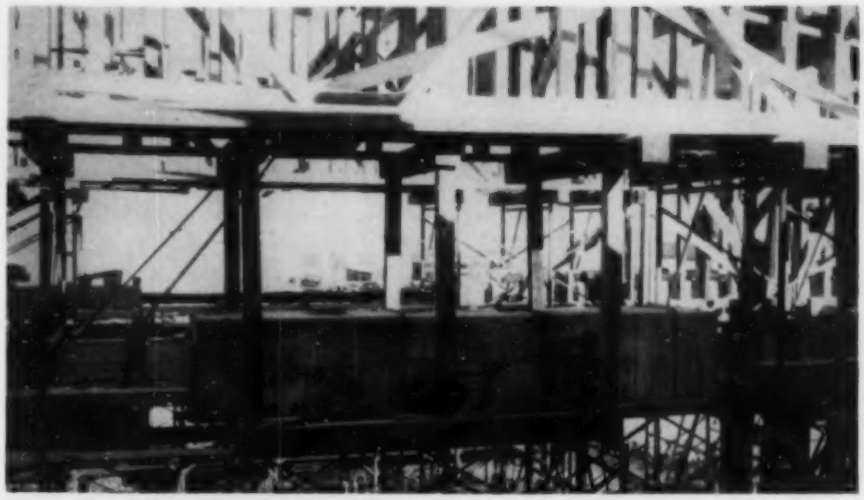


FIG. 1. TYPICAL SECTION OF WHARF BEFORE SHED WAS ADDED

The columns are of the same width as the arch rib, 19 in., and their depth is $21^1/_2$ in. There is a hinge joint near the foot of each column at a point 8 in. above the top of the wharf deck. When the wharf was constructed, two $1^1/_4$-in. anchor bolts were built into it at each column location. Reinforcing bars were coupled to the anchor bolts and bent toward each other so as to cross at the center of the hinge and extend up into the column above the joint. A sheet of lead reduces the resistance of the joint to rotation.

Each arch tie is composed of eight bars $1^1/_2$ in. in diameter, as larger bars were unobtainable in the length required. The bars are in contact with each other in a compact group except at the ends, where they flare away from each other so as to have a properly bonded connection to the concrete at the ends of the arch rib. The ties are supported at mid span and at the quarter points by sag rods connected to the arch rib. Bolted clamps hold the group of tie bars at the sag rods and at the points where the curves for flaring the ends begin. A short piece of $1^1/_8$ square bar placed in the top and bottom of the group of bars at the clamps prevents displacement of the bars. The ties and the sag rods are covered with concrete.



ELECTRIC OVEN IN POSITION ON GROUP OF TIE RODS

An unusual feature in the construction of the bents was the method for reducing the secondary bending stresses in the columns. The rotation of the ends of the arch rib, resulting from the elongation of the tie and the shortening of the rib under stress, was found to produce an excessive bending stress in the slenderest columns that could safely be used, even when the point of contraflexure was brought to the foot of the column by the introduction of a hinge joint there. After careful consideration of the various expedients that might be used for overcoming the difficulty, it was decided to heat a portion of the length of the tie rods before concreting them into the arch and to keep them heated until the concrete in the arch rib had attained sufficient strength to bear the stresses produced by the cooling of the rods.

Under maximum load, including the grain gallery, the computed elastic elongation of the tie is 0.566 in. and the shortening of the rib, measured along the chord at the center line of the tie, is 0.114 in. It was decided to shorten the effective length of the tie 0.45 in. by preheating and cooling. The load on the arch when the tie is allowed to cool is the dead load of the arch rib, the tie, and the pre-cast purlins. Under this load, the amount of tie shortening required to produce zero deflection of the arch would be 0.296 in. The initial shortening of 0.45 in. therefore produces a negative deflection or hogging of the rib when the tie is allowed to cool. The amount of the negative deflection at the center of the span was computed to be 0.264 in. and the positive deflection under the maximum load, 0.395 in. Actual deflections of the arches, measured after the cooling of the tie rods, were in close agreement with those that had been computed.

For heating the rods, electric ovens equipped with thermostat switches were used. Heating by passing low-voltage current directly through the rods would require for the completion of the circuits very heavy copper conductors which would be difficult to obtain, and the connections between them and the rods would involve difficulties and uncertainties. With steam heating the temperature could not be so accurately controlled and regulated and the equipment for it could not be so quickly installed and removed.

Details of the ovens are shown in Fig. 3. Each oven is a box of sheet steel having double walls 3 in. thick, filled with rock-wool insulation, and lined with a $^1/_2$-in. asbestos board. The box is 10 ft. long, 17 in. high, and 12 in. wide inside. Openings are provided in the end walls through which the group of tie rods pass. The entire front wall forms a hinged door to which is attached the portions of the end walls in front of the openings so that when the door is open the oven can be installed around a group of tie rods assembled in place in the work.

When the oven has been placed on the tie rods and the door closed, a clearance space provided between the group of rods and the edges of the openings in the end walls is packed with rock wool. Plastic packing previously placed in the spaces between the rods completes the closure of the ends of the oven against the entrance of cold air.

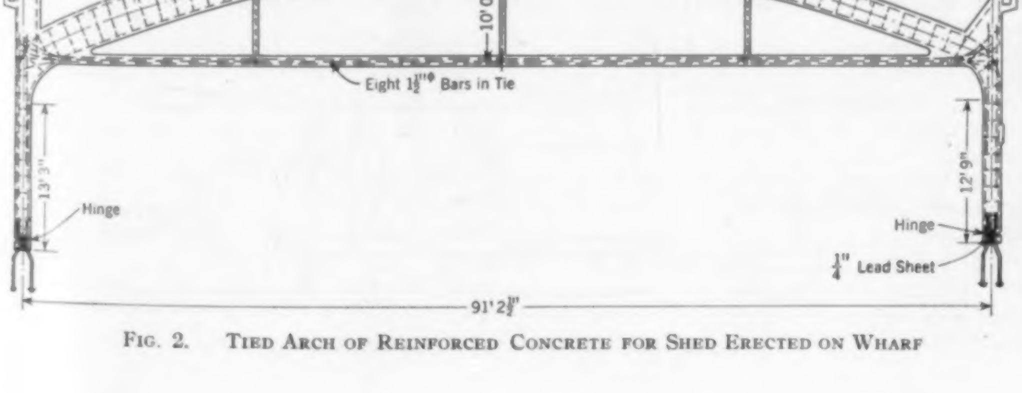
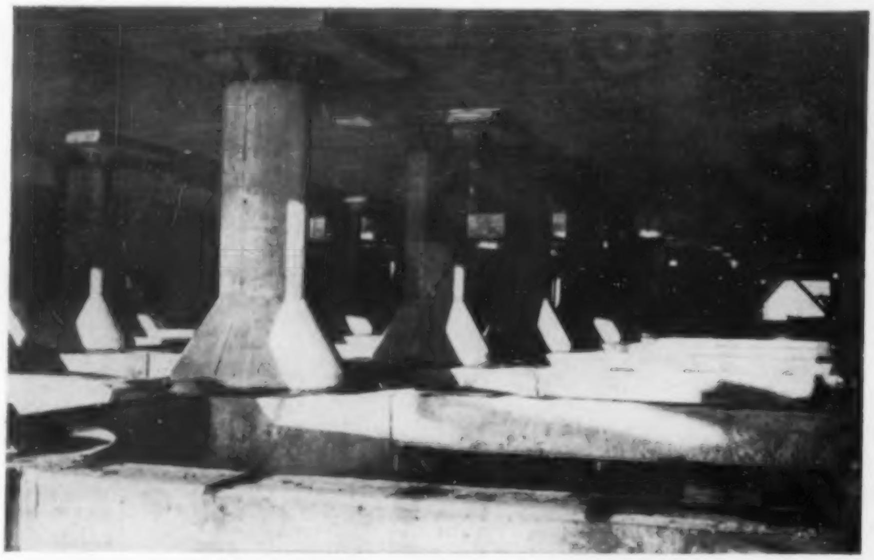


FIG. 2. TIED ARCH OF REINFORCED CONCRETE FOR SHED ERECTED ON WHARF



SHORT CONCRETE COLUMNS SUPPORTING DECK SLAB
Impracticability of Cutting Through This Slab Dictated Use of Tied Arches for Shed

Heat is furnished by six 500-w, 115-v strip heaters which are mounted in the oven along the bottom. To guard against unequal heating of the tie rods, an inclined baffle plate is set above the heaters to protect the rods from direct radiation and to cause the air within the oven to circulate around them. The electric circuit passes through a thermostat switch attached to the outer rear face of the oven and connected to a temperature bulb mounted at a point within the oven where it will be close to the top of the tie rods. The switch may be set for any temperature between 430 and 530 F and will open the circuit whenever the temperature of the bulb rises more than 6.5 F above that for which it is set, and close it again when the temperature falls to that value. Two warning lights are connected across the circuit, one in front of and one behind the thermostat switch. The heaters are connected in three groups of two, the two heaters in each group being in series and the three groups in parallel. Snap switches enable two or four heaters to be cut out when desired. A mercury thermometer passed through the top of the oven and supported by friction at the rock wool packing, enables the temperature of the oven to be read directly.

To produce the desired elongation of 0.45 in. in the eight $1^1/_2$-in. bars forming the tie, their heat content must be increased by approximately 34,000 Btu or 10 kwhr. The actual temperature required in the oven to give the desired elongation depends upon how much additional heat there is in the portions of the bars outside the oven. A temperature 415 F above that of the atmosphere was found suitable. As there were six ovens, six bents could be concreted at once. After the arch was concreted, the tie had to be maintained in its heated state for some days to avoid stressing the structure before it had strength to resist.

At two bays in each of the long sections of the shed, and at one bay in the short section, the arch ribs at each side were connected to each other by concrete diagonals 14 by 14 in. in cross section, forming a Warren truss. The other arch ribs receive lateral support from the braced bays through the purlins. No lateral support other than that furnished by the roof deck was considered necessary for the roof beams of the loading platform annex.

The cargo doors are the most important feature of the shed from an operating point of view. The horizontally sliding type is the least expensive of the several suitable types but in Saint John considerable difficulty is experienced in keeping the bottom guides free of ice, particularly at the front of the sheds, where the guides are not clear of the deck and open underneath. Doors of the vertically sliding type and of the turnover type, which also move vertically in opening, were used in the steel sheds and gave much less trouble from freezing at the bottom. For such doors, however, all-steel construction is desirable, and a considerable amount of metal work is required in their counterweights and operating machinery. Because of the shortage of steel, horizontally sliding doors of timber with steel frames were used. For the front of the shed, and in one bay at the rear, the doors are 16 ft high; all other rear doors are 9 ft high. Each opening is served by two door leaves hung from parallel tracks running continuously from end to end of each main group of door openings. Windows 6 ft high were provided in the upper part of doors 16 ft high, and in the wall above doors 9 ft. high.

Above the cargo doors at the sides of the shed, and above, below, and between the windows, the wall consists of a reinforced concrete slab 6 in. thick, built flush with the faces of the shed columns and concreted monolithically with them. The slabs are supported laterally at the eave by a concrete eave gutter built along the outer face of the slab. At the top of the doors and windows, and at the bottom of the window openings, horizontal beams were formed on the inner faces of the slabs. At the floor the slab was built into a shallow groove chipped in the top of the deck slab of the wharf.

The end walls of the building are of brick, 13 in. thick, the west end wall enclosing the outer portions of the reinforced concrete columns and beams which form the framework of that end of the building. The east end wall serves as a firewall against the adjoining shed.

The Acme Construction Company of Saint John, N.B., was the general contractor for the work. The members of the National Harbors Board are R. K. Smith, chairman, J. E. St. Laurent, vice-chairman, and B. J. Roberts. F. W. Riddell is executive secretary and E. G. Cameron, chief engineer.

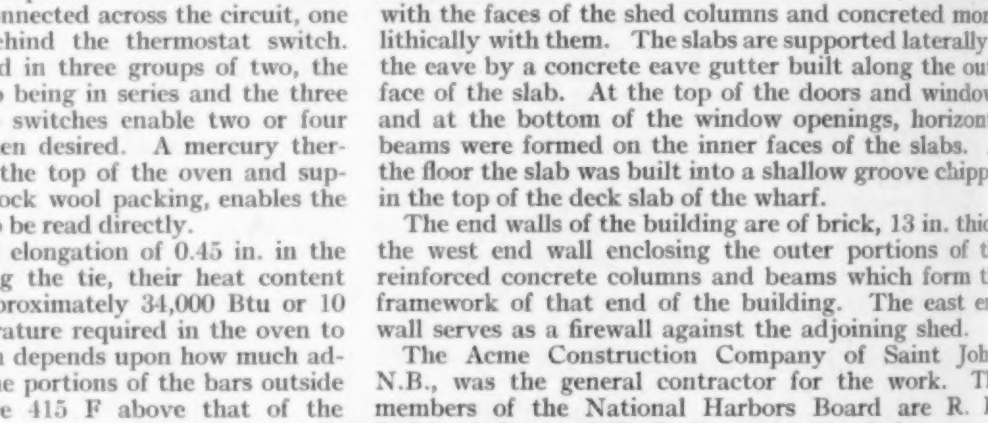


FIG. 3. ELECTRIC OVENS FOR HEATING THE ARCH TIES

The Design of Recent TVA Projects

IV. The Kentucky Dam, Power House, and Lock

By E. H. WEILEMAN

PROJECT ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

LOCATED near the mouth of the Tennessee River, just above its confluence with the Ohio, the Kentucky Dam impounds a reservoir nearly 200 miles long. Because of its nearness to zones of earthquake disturbance, all parts of the main dam were proportioned to resist seismic loads. The miter gates for the single-lift lock are among the largest ever built. This article by Mr. Wieleman is the fourth in the series on the TVA.

THE Kentucky project, located immediately above the confluence of the Tennessee and Ohio rivers, has several unique features, which distinguish it from the typical main-river plants of the Tennessee Valley Authority. In the upper half of its length, the Tennessee River falls at a rate slightly less than 1 ft per mile, then, upon leaving the historic Muscle Shoals in the vicinity of Wilson Dam, flattens out considerably, and for the last 200 miles drops about $^1/_4$ ft per mile. In other words, a dam creating a head of 50 ft at the mouth of the river would impound a reservoir 200 miles long.

During the Ohio flood of 1937, which raised the water level at the mouth 45 ft above low-flow conditions, natural valley storage in the flood plain of the Tennessee formed a mammoth lake only slightly less extensive than the artificial reservoir now established for normal headwater conditions. Obviously no safe habitations are possible in such a flood plain, subject to the constant threat of serious inundation. Thus the establishment of a major terminal retention reservoir at the Kentucky site followed logically and directly from natural hydraulic and topographic conditions.

By making fullest utilization of the natural features, it was found possible to obtain a reservoir with a controlled flood storage of 4,600,000 acre-ft, sufficient to retain the flood flow of the Tennessee until the peak flood on the Ohio has passed. Routing computations indicate that when operated in this fashion, the Kentucky Reservoir is capable of reducing maximum stages on the Mississippi between 2 and 3 ft below Cairo, Ill.

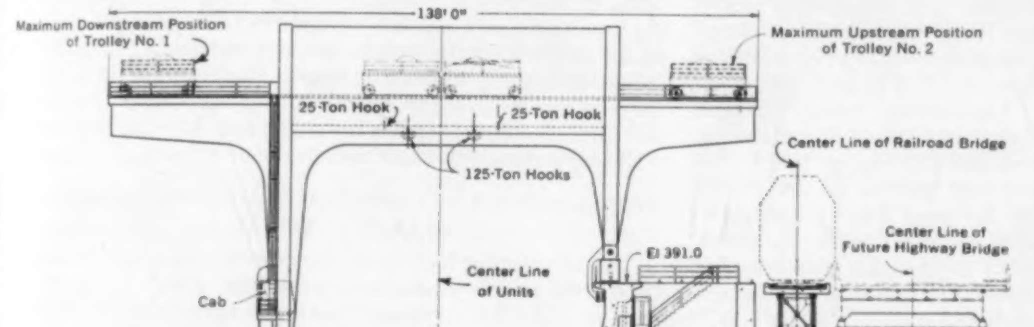


FIG. 1. CROSS-SECTIONAL ARRANGEMENT OF THE POWER STATION

From the standpoint of water-borne commerce, the project will release water to augment low flows in the Ohio and Mississippi and will provide a 9-ft channel for navigation upstream to the Pickwick Project, a distance of 184 river miles. The lockage facilities provided are commensurate with the importance of the development as the gateway to the river transportation system of the Authority. As a result of extensive upstream development and the flexibility in operation permitted by its own great reservoir, the project is also a valuable addition to the integrated TVA power system.

The Kentucky project is distinguished from the eight other main-river developments not only because preponderant emphasis is placed on the flood storage function, but also because foundation conditions at the site had a noteworthy effect on the layout and size of its structures. At the eight other dams, the natural river bottom consists of bedrock, but in the area of the lower Tennessee, bedrock is generally from 200 to 300 ft below the present stream bed and overlain with layers of sand and gravel, increasing in coarseness with

Lower Miter Gates of the Navigation Lock, Keyntuck Project

the depth. One of the factors determining the selection of the site finally adopted for the Kentucky Dam was the occurrence of bedrock suitable for foundations only 45 ft below the river bed. Even at this reduced depth the unwatering operations during construction involved steel sheet-pile cofferdams of unprecedented size and height and permanent hydraulic structures far exceeding in height and massiveness those of the other main-river developments.

At the project site the river channel and flood plains have an aggregate width of about 1.6 miles, with fairly steep hillsides beyond, to form the abutments of the dam. The wide flood plain on the west side shows two distinct levels, the present active plain at El. 330 and the abandoned plain at El. 350. Underlying these terraces formed by river alluvium of sand and gravel is a siliceous, cherty limestone, generally at El. 230, rising to El. 250 near the east edge of the river and then to El. 300 in the vicinity of the lock. Below the west end of the flood plain, the bedrock rises rapidly and reaches El. 350 under the massive western highlands. Numerous deep solution channels were encountered during foundation excavation and required extensive cutoff treatment.

The navigation lock was located on the east bank of the river to take advantage of the relatively high elevation of bedrock there suitable for foundations, thus reducing the total concrete yardage for the large lock structures. This location was also favorable from the navigation standpoint, since it permitted the excavation of a sheltered downstream approach channel in the overburden of the natural flood plain.

Where the foundation rock was highest within the limits of the river proper, the power station was placed. This is in the main-river channel directly adjacent to the eastern flood plain. In this vicinity the elevation of solid rock corresponds closely with the required bottom elevation of the draft tube, resulting in a minimum of excavation. The remaining island between the lock approach channel and the power station provided space for the switchyard. The spillway is located in the central portion of the main-river channel so as to afford straight downstream alinement for flood discharges. An earth embankment 5,900 ft long extends over the wide western flood plain.

Upstream Face of Power Station and Portion of Spillway During Construction in First-Stage Cofferdam

Upon completion of the project, the present Illinois Central Railroad bridge below the dam will have to be removed. The new railroad crossing is incorporated in the design of the power station and dam structures directly upstream from the spillway and intake decks.

EARTHQUAKE-RESISTANT SECTIONS

Owing to the proximity of the site to the secondary zone of disturbance of the New Madrid earthquake of 1812, all structures forming part of the main dam were proportioned to resist seismic disturbances. The following seismic loadings were adopted: for mass structures of great rigidity an equivalent inertia force equal to $0.05g$, and for less rigid structures an inertia force varying from $0.06g$ to $0.10g$, based upon rational calculations of the dynamic action of the structure. The seismic increase in reservoir pressures was calculated by the Westergaard formula, using an earthquake acceleration of $0.05g$.

For the two large retaining walls at the end of the earth embankment at each side of the river, special investigations were undertaken to establish the proper seismic loading. An extensive program of shaking-table tests was conducted at Leland Stanford University by Prof. L. S. Jacobsen as consulting engineer. On the basis of these tests an equivalent inertia force of $0.18g$ was applied to the conventional Coulomb wedge, the point of application being about 0.60 the height above the base. For structures sustaining hydraulic loads, the increase in overturning moment due to seismic effect was only 7%, while the corresponding increase for structures such as retaining walls carrying earth loads was in the order of 35%.

MITER GATES FOR NAVIGATION LOCK ARE AMONG LARGEST EVER CONSTRUCTED

The navigation lock is of the conventional Ohio River type with usable chamber dimensions of 110 by 600 ft. It is a single-lift structure having a normal lift of 55 ft and a possible maximum lift of 73 ft. The miter gates are among the largest ever constructed; each lower leaf is about 62 ft wide by 93 ft high and weighs about 650 tons.

A floating emergency caisson of the type commonly used for large dry docks is provided for unwatering either set of miter gates for inspection and maintenance. As an additional precaution against the remote contingency of simultaneous damage to both upper and lower miter gates, inserts have been installed in the masonry adjacent to the miter gate seals to accommodate poiree dams like those provided at the Pickwick project.

The filling and emptying system consists of a main longitudinal conduit in each lock wall with lateral ports to the chamber and the upper and lower pools. Extensive hydraulic laboratory model tests were conducted upon several competing types. The system described, though slightly less economical on paper than the venturi loop system of the type installed at Ymuiden, Holland, was selected to avoid the hazard incidental to pioneering on so large a structure, with such a high lift. The filling valves are of segmental type, constructed of structural steel and electrically operated.

As the elevation of bedrock drops sharply in the locality of the upper guard wall, a floating type boom was adopted to avoid the prohibitive expense of constructing heavy foundations under such adverse conditions. The boom, a structural steel shell with watertight bulkheads, is ballasted with concrete to insure the requisite stability. It is anchored at the lock end to a carriage traveling on rails in a slot provided in the terminal block of the concrete lock structure. This slot permits free vertical movement as required by changes in the upper pool elevation. The upstream anchorage of the boom consists of two long steel chains anchored to massive submerged concrete blocks.

Navigation Lock During Construction
Looking Upstream from the Temporary Railroad Bridge

DESIGN OF THE POWER STATION

Figure 1 shows the general cross-sectional arrangement of the power station, a structure of the so-called semi-outdoor type, specially adapted to accommodate high tailwater conditions. The controlling elements of design parallel in general those of the Watts Bar and Fort Loudoun projects, discussed in the May issue of Civil Engineering. Because of the location of the railroad bridge upstream from the intake, the trash racks were placed in a slot back of the skimmer wall.

Owing to the comparatively great depth to bedrock in relation to the elevation of minimum tailwater, it was possible and economical to set the center line of the turbine blades relatively low, with the result that cavitation was not a controlling factor in establishing the runner diameter, and the size of wheel could be selected as the smallest capable of furnishing the requisite power. This permitted purchasing generating machinery in the upper range of speed for the required head and output with a proportionate reduction in capital cost, the height of the hydraulic structures being fixed by the natural elevation of bedrock.

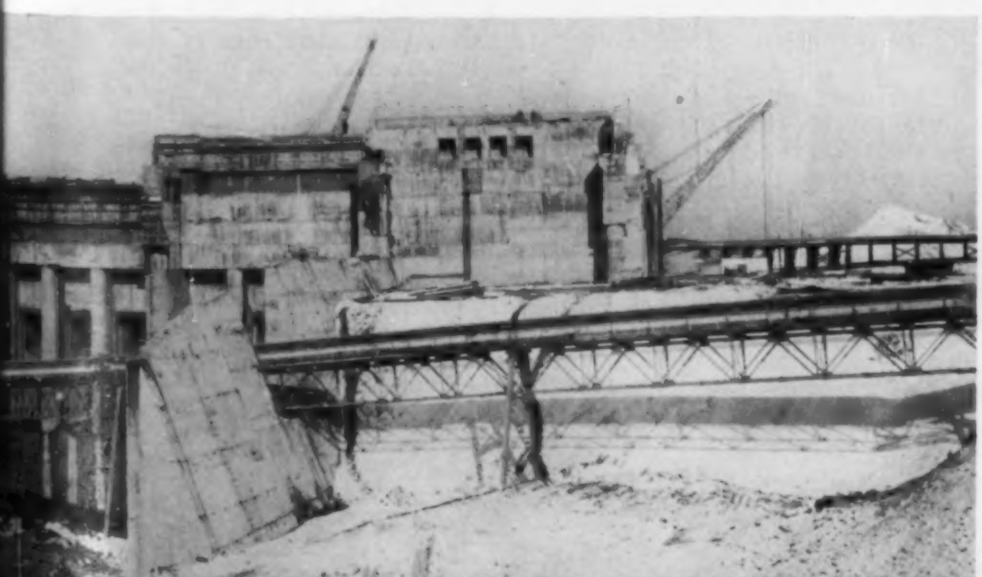
In accordance with standard TVA practice for low-head installations, the combined mass of the intake and turbine substructure is utilized to resist hydrostatic overturning. The electrical bay is then located on the downstream side of the station above the draft-tube piers. This practice conforms with the basis hydraulic requirements of the turbine setting. Since the intake velocities are low, the resulting head losses tend to be proportionately small, and no refinement in waterway contours is necessary over and above that required to guide the water to the turbines smoothly and without the formation of objectionable eddies. On the other hand, the exit velocity from the runner is comparatively high, requiring a long carefully proportioned draft tube to regain the relatively high proportion of the total available energy in the outflowing discharge from the wheel.

The power-station gantry crane, of 250-ton capacity, will be used for handling the generating units, operating intake and draft-tube gates, and main transformers and auxiliary equipment. It is arranged to pick up materials directly from the railroad siding upstream of the service bay. Since the operating decks of the intake and spillway are at the same elevation, the two spillway gantry cranes, each of 100-ton capacity, will be available for use at the power station intake as well as at the spillway.

SPILLWAY LAYOUT AND OPERATION

Under the normal cycle of operation, headwater will usually vary from El. 354 to El. 359, as determined by the need for releases to augment low-flow conditions on the Ohio and the Mississippi. During operation for flood control, the reservoir level may reach El. 375, and in anticipation of an impending flood may be lowered to El. 346 to increase the available storage capacity.

The maximum design flood to be discharged is 960,000 cu ft per sec; but the controlling element for spillway layout is the drawdown condition. To be able to lower the reservoir level effectively in advance of a flood, the masonry crest of the spillway (as shown in Fig. 2) was selected at El. 325, with gates 50 ft high. The total spillway capacity with reservoir at El. 375 is far greater than the design flood and amounts to 1,270,000 cu ft per sec.



The spillway is built in blocks 49 ft wide. In order to provide stability for seismic loads acting parallel to the

axis of the dam, a part of the contraction joint between blocks is grouted after cooling.

There are three gate leaves per bay. For these the fixed-roller type was selected as the most flexible and economical for multipurpose operation. Under normal conditions, with the reservoir at El. 359, only the two lower gate leaves will be in place on the crest; the upper

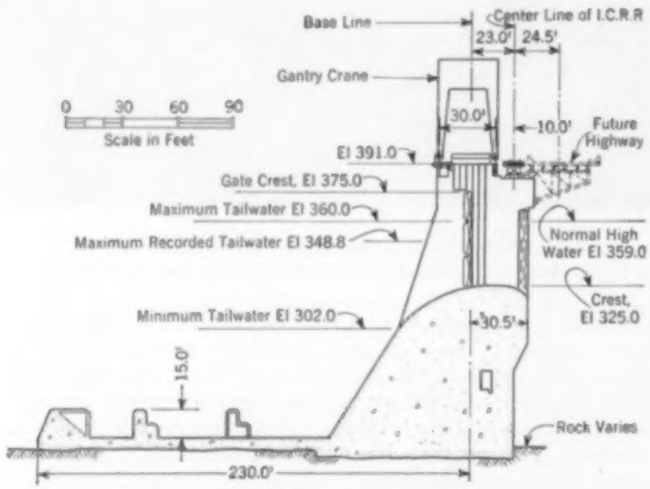


FIG. 2. CROSS SECTION OF THE SPILLWAY

leaf will normally be kept in storage directly beneath the spillway deck. This design would permit the passage of a very substantial flow over the tops of the second or intermediate gate leaves at El. 360 if the spillway operating equipment should be out of order. Although the probability of such an emergency is exceedingly remote, this design provides a desirable margin of insurance commensurate with the reservoir capacity and the magnitude of the anticipated floods.

Two 100-ton gantry cranes operate the spillway gates. An emergency gas-engine generator set has been installed in the power station to insure continuity of service in the event of failure of the main power supply. A distinctive feature of the design of the gate-hoisting equipment is the substitution of heavy single-line chains terminating in torpedo-type automatic grappling blocks, operating wholly within the protection of the gate slots, for conventional multipart sheaves reaved with several lines of wire rope. The chain links are provided with guide lugs engaging the rails of the gate slot and affording a simple, yet positive, means of preventing the chains from being pulled out into the overflowing discharge and fouled. It would, of course, be impossible to operate lifting beams through the overflowing discharge.

An extensive program of model tests was conducted in the hydraulic laboratory to determine the most satisfactory mode of operating the crest gates and to establish the most effective design of apron for dissipating the energy of the spillway discharge. The tests demonstrated that, with the facilities provided, there will be no occasion for operating gate leaves under partial openings. In other words, each individual gate leaf will either be fully inserted or completely removed, resulting in a simple, workable schedule of gate operation.

The exceptional depth of tailwater available at all times (from 50 to 100 ft) was found to be a very substantial factor in dissipating a large part of the energy of overflow directly in the tailwater itself. To assist in the formation of the back roller requisite for this purpose, a horizontal apron is provided extending 230 ft downstream and equipped with two rows of staggered baffle piers and with a dentated sill at the downstream end. With this apron and an overburden excavation on a 1-on-7 slope, no objectionable erosion was noticed for any discharge. Piezometer measurements also failed to reveal any tendency to cavitation on the baffle piers, probably because the great depth of tailwater provided substantial positive pressures and thus inhibited any tendency toward the formation of vapor pockets.

EMBANKMENTS HAVE IMPERVIOUS CORES

An earth embankment 5,900 ft long extends from the spillway to the west abutment. Short sections of embankment are also used between the power station and the lock and between the lock and the east abutment. A typical embankment section consists of an impervious core, rolled to a 1-on-2 slope and blanketed with pervious shoulders having 1-on-4 slopes.

To limit seepage through the gravel overlying the bedrock, a steel sheet-piling cutoff was used in the west embankment for 1,500 ft from the spillway, and for the full length of the embankment between the power station and the lock. The short section of fill east of the lock was rolled on bedrock. Rock under the embankments was usually grouted from the surface of the natural overburden.

HIGHWAY, RAILROAD, AND UTILITY RELOCATION

It is calculated that the reservoir will have an area of 295,000 acres under a backwater curve corresponding to a flow of 200,000 cu ft per sec and with the surface at El. 375 at the dam. It was necessary to raise, relocate, or protect about 280 miles of highway and 110 miles of rural roads. It was also necessary to raise and relocate 35 miles of main-line railroad track.

The following main-river bridge crossings were affected by the filling of the reservoir to El. 375, or because of relocations of highways or railroad tracks:

1. Eggners Ferry highway bridge, about 3,400 ft long, is being raised approximately 25 ft. The raising of the approaches will require about 1,500,000 cu yd of fill.
2. Scott-Fitzhugh highway bridge, about 4,600 ft long, is being raised approximately 17 ft. Raising of the approaches will require about 1,400,000 cu yd of fill.
3. Louisville and Nashville Railroad bridge, about 1,600 ft long, is being raised approximately 20 ft. A temporary timber trestle is being built to bypass the railroad during the raising of the bridge. It will require approximately 1,200,000 cu yd of fill to raise the approaches.
4. Trotters Landing highway bridge, about 3,700 ft long, is being raised approximately 4 ft for a portion of its length. A new bridge for the Nashville, Chattanooga and St. Louis Railway will also be built paralleling the highway bridge, to replace the present railroad bridge at Johnsonville. A new lift span is required for the railroad bridge; all other spans will come from the existing Illinois Central Railroad bridge at the Kentucky Dam, which will be abandoned after completion of the dam. The new railroad bridge approaches require approximately 980,000 cu yd of fill.

In addition to the highway and railroad construction, there are a series of dewatering or malaria-control projects consisting of levees and pumping stations, the levees being high enough to keep out the normal water of the reservoir from April to October. In this period the areas dammed off by the levees will be drained by pumping when required. The total pumping capacity necessary for this purpose for all dewatering projects is about 655,000 gal per min. During the winter and early spring these areas will be flooded and will be part of the reservoir.

Shipyard Assembly Lines

Two New Yards Cut Shipbuilding Time in Half

By Adolph J. Ackerman, M. Am. Soc. C.E.

Director of Engineering (and Plant Expansion), Dravo Corporation, Pittsburgh, Pa

The assembly-line method has been used in shipyards to facilitate the pre-assembly of large sections of ships and barges. In this method, the ships move ahead as assembly progresses until they reach the launching position. Erection and pre-assembly crews meanwhile remain at fixed stations. The ships are launched sidewise. This is the second part of a paper presented by Mr. Ackerman before the Construction Division at the Society's Annual Meeting in New York.

Immediately following Pearl Harbor, the Navy initiated a tremendous increase in its program of shipbuilding, and sponsored numerous new shipbuilding facilities on a scale defying ordinary conception. Our company was called upon to construct two new yards, one on an inland river and the other on Eastern tidewater. These yards are a direct outgrowth of the experience and methods developed during the preceding ten years. ("Mass Production Methods in Shipyards," by the writer, Civil Engineering, May 1943, page 201.)

The number and type of ships to be constructed in each yard having been established, the general planning of requirements for the new yards was immediately undertaken. Preliminary estimates were prepared for the Navy in order to crystalize this program and allow prompt commitments to be made with respect to engineering and construction services. This was followed by more detailed analyses of operating requirements and better estimates of cost, while preliminaries were getting under way.

Particular tribute is paid to the Facilities Section of the Navy Bureau of Ships, which was responsible for reviewing all the general facilities layouts and getting the programs under way. The so-called "red-tape" was nonexistent, and decisions were made almost immediately and on a sound basis. It is noteworthy that the Navy Department clearly understood the importance of providing the most modern production facilities and equipment.

Those in the construction industry will be quick to realize that it takes considerable courage in planning a new job to invest enough money at the start in plant and equipment so that the operation is the most economical. A normal tendency among the less experienced is to install the cheapest possible plant that will "get by." The remarkable record and general success of the Navy's shipbuilding program are to a considerable extent due to the vision and courage that directed construction of the best and most suitable types of shipyards and facilities.

For the enlargement of the inland river shipyard, several alternative arrangements were considered, including the complete development of an entirely new yard at another location. In such a yard, there would have been considerably more freedom in layout to suit the requirements of modern production methods and the flow of pre-assemblies and materials. However, it was estimated that it would take 6 months longer to develop such a yard and start operations in it.

It was therefore decided to develop two principal areas of the existing yard, which are known, respectively, as the West Yard and the East Yard (Fig. 1). The West Yard, containing the original company plant, was expanded with a limited number of buildings, and extensions to shipways. The East Yard is entirely new. The two yards are separated by other industries.

The East Yard was the only large vacant area in the vicinity of the existing plant which could be developed. The production program of this yard was laid out on the basis of lauching one hull a week from the ways and delivering one ship a week from the outfitting dock. The ships are of all-welded construction, ocean-going type, and are of a relatively simple design with a minimum of equipment and outfitting. They are more than 300 ft long and correspond more to tankers than to freighters or combat vessels. The completed ships proceed down the river to the ocean under their own power.

The structural fabricating capacity was not expanded because a considerable number of structural-steel fabricating shops were available in this general territory to build pre-assemblies in box form to maximum railroad

Shipways of Eastern Tidewater Yard During Construction

Track Beams Shown at Launching Ways, Left

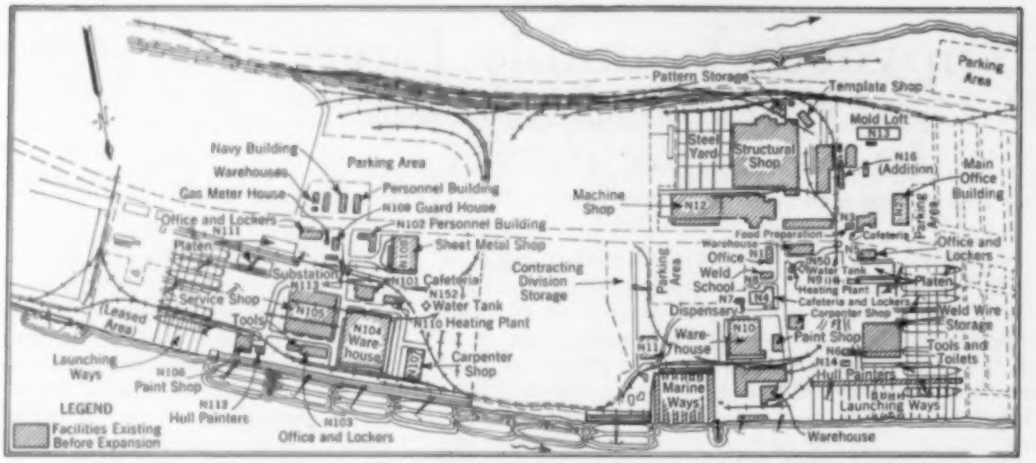


FIG. 1. PLAN OF AN INLAND RIVER SHIPYARD (AREA BEFORE EXPANSION SHADED)

shipping size. These boxes are brought into a storage area near the plant, whence they are delivered as required to the assembly yard. In this way advantage was taken of the existing facilities of a number of established structural shops. The structural shop and the old and new mold lofts in the shipyard were utilized to construct the more difficult pre-assemblies involving curved work, such as bow and stern ends, which the average commercial structural shop is not prepared to make. These represent about 20 to 25% of the total fabrication on each ship.

Two hull assembly lines were required to maintain the proposed schedule. One was located in each yard on the river front, about 25 ft above normal river level. This elevation resulted in an unusually long launching distance, but was necessary to stay above the more frequent flood levels.

In the early stages of planning the assembly areas, consideration was given to constructing a large enclosure over two or three of the shipbuilding berths to insure uninterrupted assembly of hulls, free from interference from weather. Experience in building barges has shown that a large enclosure has a number of important advantages. However, in the present instance, the shortage of steel and the limited scope of the shipbuilding contract precluded such an installation.

The assembly yards contain large steel platen areas and shipbuilding berths (Fig. 2). These are all parallel to the river front and arranged to provide for sidewise moving of the hull from one berth to the next as it is built up. The pre-assemblies are brought to the assembly area by railroad flat cars. Either they are unloaded onto platens, where they are joined up into still larger pre-assemblies, or they go directly to the shipbuilding berths. The berths consist of grillages of steel beams, each grillage about equal in size to the area of the ship, and supported about 4 ft above the ground on concrete pedestals with spread footings. The footings rest on a well-compacted sand and gravel formation with a bearing pressure of 2 to 3 tons per sq ft.

Full-revolving whirler-type cranes on high portal-type gantries comprise the weight-handling facilities. These have a capacity of 15 tons at a 60-ft radius, and for extra heavy lifts may be used in groups of two or three of the same pre-assembly. The cranes are of the self-propelled type, traveling the full width of the assembly area, and receive their power through collector arms extending down into a trench containing the power-supply trolley wires. All yard piping for air, water, and steam is underground, as is also the entire electric power system. The assembly area is well illuminated by floodlights supported on 100-ft timber towers.

When enough of the pre-assemblies have been installed and tack-welded together on the first berth to form a unit, this is moved by means of the transfer carriages. The first stage of the hull is transferred to the second position, where additional pre-assemblies are added, while a new hull is started on the first position.

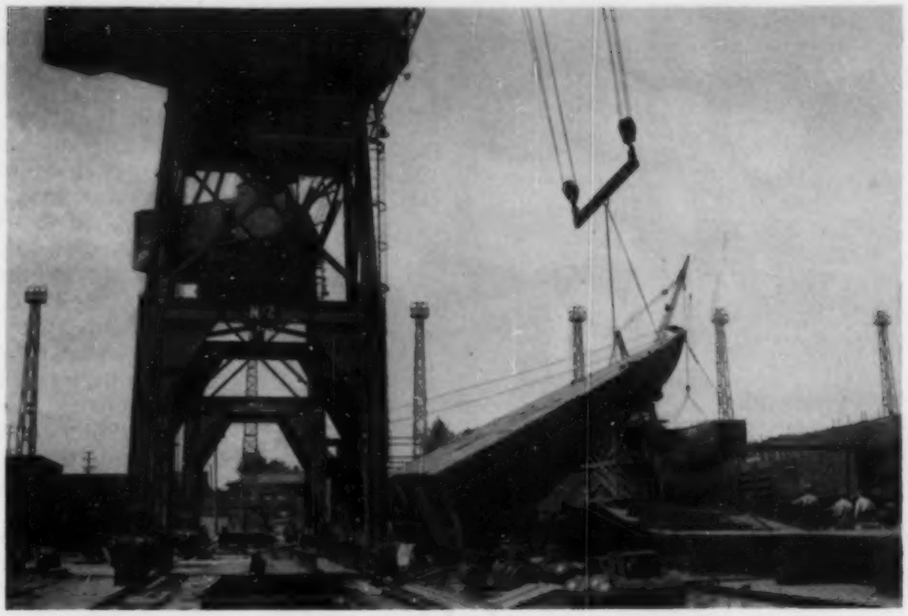
The same transfer system is used as was employed in earlier years in the handling of barges on a production line. After one hull has been launched, a group of 16 transfer carriages or buggies are rolled under the next hull adjacent to the launching ways. These carriages (see an accompanying photograph) travel on the inside of channel tracks mounted on concrete runway slabs. Six of these runways extend the full length of the shipyard at right angles to the shipbuilding berths.

Each carriage is capable of lifting 120 tons. On a given signal a man at each carriage begins to pump

EASTERN TIDEWATER YARD; BERTHS IN BACKGROUND, PLATEN AREA IN FOREGROUND

oil into the hydraulic jacks mounted on the carriage. In this manner the hull is lifted from its blocking and supported entirely on the carriages. The hull is pulled to the next position by a cable connected at about the center of the hull's side. An electric hoist furnishes the motive power. After the hull has reached its new position, the hydraulic jacks are released and the hull is transferred to the blocking. The carriages are then rolled back to the next hull and it is moved in a similar manner to the berth that was just vacated. This operation is repeated until all the hulls have been moved sideways one position, leaving the No. 1 berth vacant for a new keel.

Each hull remains in a given position about one week, and passes through several stages of tack welding; final welding; compartment testing; partial installation of piping, wiring, and outfitting; and installation of miscellaneous deck-house pre-assemblies. Each berth is designated to carry on its specified group of operations, and in this manner the hull goes through a conventional assembly line until it arrives at the launching position. The necessity of removing the scaffolding each time a hull is shifted sidewise is overcome by hanging the scaffolding directly on the hull and allowing it to travel with the hull until it reaches the final position.



TWO REVOLVING GANTRY CRANES SHIFTING THE STERN SECTION OF A SHIP
Assembly Berth in Background

LAUNCHING PROCEDURE

At the launching position, the hull transfer carriages travel out over a group of tilting track beams which are temporarily blocked in a horizontal position. Six launching sleds, mounted on the groundways between the track beams at 48-ft centers rest on a coat of grease and are tied to the upper end of the groundways with heavy ropes. The hull is lowered onto the sleds by means of the hydraulic jacks on the carriages, and the carriages are then rolled out from under the hull. The tilting track beams are lowered at the outboard end so that they are clear of the moving hull when it is released. When the hull is launched, all six ropes are cut simultaneously with axes.

Groundways are set on a slope of $1^1/_2$ in. per ft and supported on stepped concrete slabs in the stable portion of the river bank, and on piling at the water's edge. No cofferdams were required for the construction of the outboard end of the ways, as they terminate at about water level, where they rest directly on steel cylinders filled with concrete doweled into the bottom by piling. Dredging at the end of the ways is carried deep enough for the maximum draft of the vessel, plus sufficient depth to readily clear out the launching sleds. The ways, about 235 ft long, are greased in the usual manner, the grease being subjected to an average pressure of 2 tons per sq ft during launching. Under these conditions, the vessel usually attains a speed of 12 to 15 miles an hour just before it strikes the water.

New buildings in the West Yard consist of two small warehouses, a first-aid station, a combination mess hall and locker building, an emergency office building built at the outset of the new program, a weld school containing 50 machines and operated day and night to train new welders, three locker and tool buildings for yard personnel, a heating plant, an extension to the machine shop, a mold loft building, and the main office building. A building, in which food is prepared for delivery to the mess halls, was constructed adjacent to the original cafeteria. Railroad tracks were extended as required, and special parking lots provided.

Besides the second line of shipbuilding ways in the East Yard, the principal activity in this area is outfitting the ships. The outfitting dock is of cellular sheet-pile construction, with its top 28 ft above normal river level, above ordinary flood stages. Because of limitations in property ownership, the outfitting dock is in two sections: one 1,365 ft long, supporting four full revolving gantry cranes, and another 300 ft long, equipped with one gantry crane. By double berthing, a total of twelve ships can be tied up between the ends of these two docks. This provides ample berthing space for outfitting each ship.

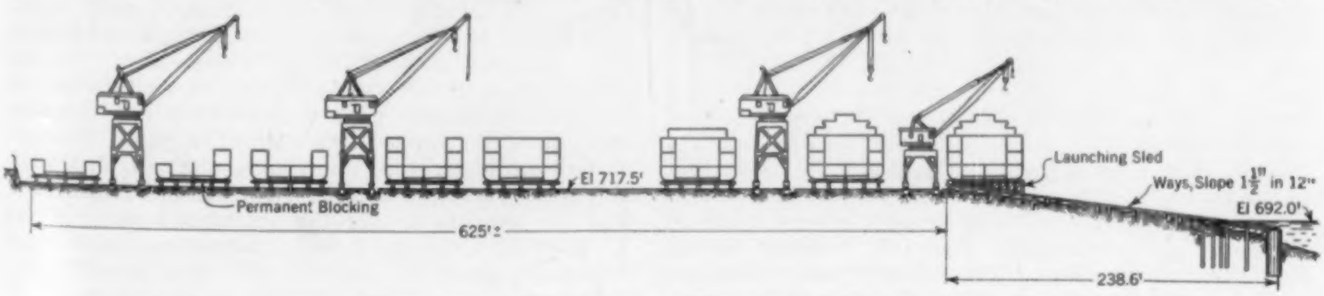


FIG. 2. A SECTION THROUGH THE WEST YARD SHOWING THE SEVEN BERTHS AND LAUNCHING WAYS

Ship-Transfer Carriage at an Intersection of Channel Tracks

These Are Hydraulic and Are Manually Operated

Buildings in this area include a service shop which houses the activities of the outfitting machine shop, pipe fabrication department, and electrical department. A separate sheet-metal shop houses the fabrication of the thin plate work, and a separate carpenter shop the woodwork and rigging. A large warehouse carries most of the items required in outfitting and is located directly in front of the outfitting dock. There are also four tool rooms and three toilet and locker buildings for yard personnel. Two office buildings and two warehouses, initially used by the subcontractors, were later converted to yard operating requirements. This area is served by a separate central steam-heating plant and compressed-air plant, a centrally located mess hall, employment and hospital building, and guard house.

All the shops, warehouses, locker and yard office buildings, are of timber truss or timber frame construction with asbestos shingle siding. The only exception is the machine shop extension, which is of steel framing because of the heavy crane loads. Certain buildings such as heating plants, fire apparatus and guard house, food-preparation center, and the main office building, are of brick construction to make them substantially fireproof. However, in the timber structures special precautions were also taken to protect against fire.

A maximum of 2,200 men were employed in the construction of this yard. A single shift of ten hours a day took care of the inflow of materials, which at that time were subject to strict priority control. This yard had an "AA-1" priority, the highest obtainable for construction work, which assured reasonably continuous operations, to permit laying the first keel in the West Yard June 10, and in the East Yard June 29, 1942. The first launching in the West Yard was September 7, and in the East Yard, September 19. All facilities were substantially completed by December 15. From June to December there was considerable overlapping of facilities construction and shipbuilding, with some interference to both, but in this case fully justified by the emergency.

Shipyard facilities on the eastern tidewater represented in many respects an entire'y different problem. They had to be designed with complete fabricating facilities for the construction of a more complex type of combat vessel, which is to be delivered at the rate of $1^1/_2$ to 2 a month. The original yard represented only about 10% of the ultimate facilities required, but it had a nucleus of experienced shipbuilders, a reasonably good waterfront location, and particularly favorable railroad service from three separate lines. The local community also lent itself favorably to the expansion program. This yard, like the inland river yard, was laid out for operation with a total of 10,000 men on three shifts.

Local conditions such as the river, existing railroad system, nearby swamp areas, and property owned by others were factors which fixed the type and arrangement of the yard, but it is believed that the planned facilities are suitable for the work assigned to them and meet all requirements in a satisfactory way. It was necessary to divert a creek and to haul in about 750,000 cu yd of gravel fill to develop a suitable yard area.

The building berths are on the upstream side of the original yard; the outfitting dock and shop, and the main warehouse, on the downstream side. The steel storage yard and main fabricating and machine shops were located centrally with respect to these areas, at the point of entry of the railroads. In this area are also the main office building, central mess hall and food-preparation center, hospital and personnel building, and the mold loft. The entire area is interconnected with an extensive system of railroads and roadways.

Berths are in two lines, four in each line, with a fifth or launching berth all arranged for side launching as in the inland river yard. Because of unusually swampy and unstable foundation conditions, all the permanent blocking is supported on cast-in-place concrete piling, as are the gantry crane runways. The launching ways are supported on more resilient oak piling. The hull transfer system and carriages and the launching system are indentical to those employed at the inland river yard. Steel-plate platen areas and jigs for constructing hull pre-assemblies are located adjacent to berths, and in the main assembly shop under a roof. All principal buildings follow the same type of design and construction employed at the inland yard, the main fabricating shop and assembly building being the only one of structural steel.

The outfitting dock consists of timber pile bents and intermediate piling supporting two concrete girders which carry three full-revolving gantry cranes. The dock is arranged for a double berthing of 10 ships for outfitting in various stages at one time. All the utilities are underground, most of them in a 6-ft concrete pipe tunnel extending through practically the full length of the yard. This yard was constructed under less favorable circumstances than the inland yard because of a lower priority, which delayed the delivery of materials for the principal steel and timber structures.

All the new facilities in both yards are the property of the Navy, which during construction advanced a revolving fund to finance the work. The contracts for the construction and operation of both yares were awarded directly to Dravo Corporation, which in turn employed consulting engineering firms, architects, and construction organizations as subcontractors. The two programs were initiated under Capt. Philip Lemler of the Bureau of Ships. Later supervision was transferred to the Bureau of Yards and Docks under Rear Admiral Ben Moreell, Hon. M. Am. Soc. C.E., and Capt. Kirby Smith. For the inland yard, Capt. R. P. Schlabach, Capt. L. T. Haugen, and Lt. Comdr. Robert Hughes were in direct charge, and the consultants were Modjeski and Masters, and Hunting, Davis and Dunnells. Charles M. and Edward Stotz, Jr., were the architects, and the contractors were Booth and Flynn Company and W. F. Trimble and Sons Company. For the eastern yard, the supervisors were Capt. R. T. Hanson and H. E. Haven of the Navy. Charles T. Main, Inc., was the consultant, and the contractors were Edward J. Rappoli Company, the Contracting Division of Dravo Corporation, and W. F. Trimble and Sons Company.

Heavy-Duty Asphaltic Runways

Fundamentals of Subgrade and Surface Design

By Bernard E. Gray

General Manager of the Asphalt Institute, New York, N.Y.

Anticipating huge sky freighters with a total weight of 300,000 lb, airport designers are considering surfaces which will take punishing loads with a minimum of maintenance cost. The importance of varying conditions such as climate and rainfall are discussed by Mr. Gray, in this paper originally presented before the Mohawk-Hudson Section of the Society.

The building of airports, both at home and abroad, is one of our most important engineering jobs. The necessity for constructing these at a rapid rate, under various organizational set-ups, has resulted naturally enough in different methods of approach to the matter of design. Developments in the size and number of planes have been so rapid that layouts which were satisfactory a few years ago are now almost obsolete. When the huge planes now under discussion come into actual use for land travel, it will be necessary to build new runways for them as there is not at the present time a single one of sufficient size in the country.

A consideration of airplane weights shows that on a medium-duty airport for single-engine planes, wheel loads may reach 15,000 lb, while for bomber bases and air depots, provision must be made for wheel loads of 60,000 lb. These loadings (Table I) appear to govern for the present, but if we project our thoughts a little into the future it is evident that larger planes eventually will be built, although probably not until after the war.

The Idlewild Airport contemplates planes with a total weight of 300,000 lb. Discussion with the plane builders, as well as with the tire manufacturers, indicates that such a plane would probably have four wheels in line, two under each wing, spaced about 8 ft apart. They would, of course, be retractable. The tires would be approximately 96 by 36 in. in size. Theoretically, each one would therefore carry a load of 75,000 lb—a striking contrast to the 12,000-lb maximum wheel load on highways. There seems to be agreement that, with present knowledge, single tires cannot carry a greater load economically.

Since the universal use of the balloon tire, impact loading on highways has become a minor matter. The same conditions apply to airport runways. While an impact factor is used in calculating pavement thickness, it is agreed that there is but little impact except in a crash landing. Under conditions of a normal landing or even a hard landing, the soft balloon tire deflects to such a degree as to actually produce a smaller unit load on the surface than would occur under static loading.

In further contrast with highway conditions is the fact that there is very little repetition of load. Observation of a heavy-traffic runway will show hundreds of black streaks which represent the rubber worn off the wheels in landing. It is remarkable how seldom these streaks overlap. Nevertheless, repetition of load is very much more important on airport areas than on highways, because of the magnitude of the loads. In a recent discussion, Lt. Col. Hibbert M. Hill, Assoc. M. Am. Soc. C.E., of the Office of the Chief of Engineers, pointed out that with a 30,000-lb wheel load, some asphalt and portland cement pavements had failed under less than 500 repetitions even though constructed in accordance with heavy-duty highway requirements.

Table I. U.S. Army Design Loads

Type of Plane	Wheel Load in Pounds	Unit Load in Pounds	Tire Contact Area in Square Inches
Single-engine	15,000	55	273
Multi-engine (except for air bases)	37,000	65	570
Heavy-duty multi-engine	60,000	75	800

In the modern airfield there are three definite kinds of areas that must receive consideration as regards surfacing. As far as thickness is concerned, runways, except for the ends, require the least. Taxiways come next, while the "hard standings" require the heaviest type of pavement. Perhaps it would be more exact to say that the base and subgrade require special attention if vibra-

Typical Section Through Asphaltic Runway Surface Under Heavy Commercial Plane of Modern Type

CATCH BASINS OR DROP INLETS GIVE POOR DRAINAGE BECAUSE OF UNEQUAL SETTLEMENT OF AIRPORT SURFACING

tion or repetition of load is frequent. Taxiways have the most frequent repetition of moving load, and as they are usually narrower than runways, the load tends to "track" in one line. The "hard standings," and also the ends of runways when used for turn-arounds and warming-up areas, are subjected to the greatest vibration. This vibration has been particularly serious on fields built adjacent to airplane factories where each new plane must be anchored and the engine run at varying speeds for a number of hours. Surfaces that were entirely satisfactory for both runways and taxiways have deteriorated in a few days under such load conditions without proper base and subgrade control.

It is evident that the engineer must have thorough knowledge of soils if he is to design the composite structure of airfield base and surface in an economical manner. He must also have a much more thorough understanding of drainage than has been displayed so far in highway work, or in most of the airports as yet completed. Soils must be tested, not only near the surface but to a considerable depth, depending upon the character of the sub-strata. In swamp areas, it is necessary to know the depth and character of the vegetable mat, as well as the kind of soils beneath. In order to make a swamp usable, it usually is necessary to haul in fill material by truck or else to place it hydraulically. Such fills may range up to 15 ft in depth at sea level and up to as much as 40 or 50 ft where hills adjoin, requiring both cut and fill.

For example, a recent airport constructed near the seashore has a 10-ft hydraulic fill pumped over a vegetable mat some 4 ft thick. Within a month's time, this vegetable mat was compressed nearly 50%, a settlement of about 2 ft. This settlement had been anticipated, of course, and the design was predicated upon its occurrence. In such cases time-settlement curves are needed to determine when equilibrium has been reached. However, before the final surface design is made, actual bearing tests will be needed to determine what further settlement may occur under the added concentrated loads.

Now it is very easy to make a mistake in designing a pavement by simply assuming that the design depends upon soil analysis only. The location of the airport in respect to climate has a profound effect, and a procedure that is entirely satisfactory in New Mexico, for example, may be inadequate in Maine. In this war period, when an engineer may find himself anywhere, it is very necessary to take these differences into consideration. They are pointed out because most of us have had our training within a limited area, and when transported to another location, are very apt to think in terms of the types of soil and pavement with which we are most familiar. It cannot be too strongly emphasized that temperature and moisture changes must be given full weight.

For example, certain A-7 soils, generally considered very poor for road-building, and which under no circumstances would support directly a thin pavement in New York State, might be entirely satisfactory on the plateau of Bolivia. In some plateau areas there is no rainfall—nothing to produce volume changes in the soil even though the temperature range may be considerable. By merely sprinkling a little crank-case oil on the surface to keep down the dust, the engineer can provide an airport on which the very heaviest airplanes can land. And yet this same soil in New York State, surfaced with a standard highway pavement, when subjected to freezing and thawing, might become quite inadequate to withstand the repeated loading of a medium bomber during the spring months.

It should be noted that too much reliance cannot be placed upon the mere classification of soils into the standard A-1 to A-8 groups, because these groupings do not necessarily mean what they may sometimes be interpreted to mean. Soils are too frequently thought of in respect to their behavior as surface courses. The fact that they may be all right as a surfacing does not mean that they will always be satisfactory for bases. As a matter of fact, in any areas subject to frost, binder material (passing 200 mesh) should be largely eliminated. The less 200-mesh material there is in base courses of granular character, consistent with ability to place and compact, the better. With many cohesive soils, a different criterion applies, for these may undergo relatively little volume change when frozen and thus ice lenses do not occur as in gravels containing too much clay binder.

VALUE OF DRAINAGE

Anyone who has seen a large airport under construction, and particularly during the summer of 1942 when the heaviest rainfall in over 15 years was recorded, can well appreciate the value of drainage. Just why grading often is done first and drainage second remains a mystery. At least major drainage should be provided before the fine grading is started. It is to be remembered that draining an airport is a different problem from draining a highway, largely because of the area involved. A road, even a multiple-lane highway, can be drained readily with side ditches. Following the basic principle in the operation of wells, the circles of influence usually overlap under the pavement. On an airport runway this is not true, and consequently some under-draining may be desirable. This may be a pervious layer of material, or a grid system of shallow trenches filled with pervious material such as crushed rock. While it is true that pure clay soils cannot be drained, the mere size of the pavement area which may leak water still gives this grid system a great deal of merit—provided, of course, that the field is never submerged. If possible, a wide ditch should be dug around the airport; this will lower the water table even though it may take some time for maximum results.

A proper system of drainage will gradually improve the bearing power of the subgrade, contrary to the widely held view that all subgrades under a runway gradually become softened from capillary moisture. A number of airports have been observed which were in such a bad condition at the completion of paving, owing to saturated subgrades, as to warrant the belief that the surfacing

would soon break through. But once the belatedly installed drainage system began to function, lowering the water table, the runways slowly hardened and failure was averted even under the extreme rainfall of 1942.

Several years ago, when large airports first began to evolve from the rather hit-or-miss flying fields of the pioneer era, there were two schools of thought as to providing surface drainage. One group proposed the installation of drop inlets within the pavement at intervals to carry water to subsurface storm sewers. The other proposed to carry all the surface water to the edges of the runways and thence into storm sewers or ditches and away from the field. From experience it has been learned that the practice of installing drop inlets is a hazardous one, particularly in areas subject to frost, because a certain amount of surface settlement will occur, and the drop inlets are very likely to project above the surface of the adjacent pavement. On a number of airports these drop inlets were seen to stand up like monuments, while nearby were pools of water which had no way of escaping.

It can be definitely stated, therefore, that the most satisfactory method of handling surface water under any and all conditions is to provide for its removal at the edges of the runways and not at any interior point. Where the terrain favors the construction of a wide shoulder, either paved or sodded, and permits sufficient slope to remove the water from the surface to wide shallow side ditches, this is probably the best and cheapest method. If for any reason this is not practicable, storm sewers should be installed parallel to the runways. Very careful calculation of maximum runoff is necessary, and the storm sewer should be designed accordingly. Installations actually have been observed where the same diameter of pipe was laid at the lower end of the runway as at the upper end, a mile away. Of course the sewer was overtaxed by the slightest rain, and flooding of the runways was frequent—until a larger pipe was placed.

COMBINATION OF FRENCH DRAINS AND STORM SEWERS

Probably the best system is a combination of French drains and storm sewers. The French drain should be immediately adjacent to the edge of the runway so that even light rainfall is removed at once to a level below the surface, thus preventing any softening of the subgrade at the runway edge. There should be frequent cross-connections to the storm sewer so as to prevent clogging. It is a peculiar fact that often a storm sewer will be laid carefully, to a proper gradient, while the French drain will be placed in a hit-or-miss fashion, thus pocketing water and forming soft spots which would have been prevented by more careful work.

FRENCH OR BLEEDER DRAINS IN PLACE FOR SUBBASE DRAINAGE

FIELD BEARING TEST BEING MADE TO DETERMINE WHEN SUBGRADE HAS BEEN PROPERLY COMPACTED

In this whole matter of drainage, there is still altogether too much penny pinching, especially where a fixed sum has been made available for an airport. Apparently the idea is that the character of the surfacing will make up in some way for the deficiency in the drainage. If any saving has to be made, it should be in the surface; the basic drainage and grading should receive first attention. When this is properly done, the bearing power of the subgrade will be maintained to such a high degree that a secondary type of surface often will carry the load.

Some of the soil stabilization methods which are quite suitable under one condition of soil or climate may be actually detrimental for wet-weather construction. For example, an airport was recently constructed in a swamp area with 36 in. of bank-run gravel placed as a subbase. This gravel was quite free from 200-mesh material and at first was rather loose and slow to compact. However, it could stand unlimited rainfall without breaking up and gradually was made smooth and ready for the base course. This consisted of a commercial-type stabilization layer 8 in. thick, using the same gravel, except for the addition of a certain amount of fines to increase its density.

This base was placed rapidly and appeared to be stable as it was supporting heavy trucks without rutting. The surface course consisted of $1^1/_2$ in. of an open-graded stone plant-mix. Its sieve-like character permitted water to be trapped, so that the surface behaved like a blotter instead of a seal. The base course had not been completely stabilized and could still take up water, so in a very short time it had become so softened that even a light truck rutted it. On digging through the base course, it was found that the subbase was completely unaffected because it contained no fines, and was so hard that it was difficult to remove with a pick.

Several things were wrong with such a design for this location. First, mixed-in-place stabilization should not have been specified for the wet-weather conditions that were to be expected. In all probability, a base course of the gravel alone, with just a little more attention to gradation, would have been all that was required. Second, an open-graded top is not suitable for an airport surface because it is porous. Since there is no traffic to close the voids as would be the case on a highway, the surface does not properly protect the base.

In this particular case, an effective remedy was found. The porous top was filled with sand, and a seal coat was then applied so that no more water could get into the base. The subbase gradually took up the surplus water from the base course until finally the whole structure came into equilibrium, and adequate support was obtained. However, if this subbase had contained a large percentage of fines, the readjustment of the moisture content could not have occurred, and the only remedy then would have been to completely scarify and reconstruct both base and top.

Frequently one sees a macadam base being placed during wet weather on a subgrade which is cut by ruts to

APPLYING PLANT-MIX ASPHALTIC CONCRETE TO PREPARED SUBGRADE

a depth of several inches. This means that the bottom 2 or 3 in. of stone is lost so far as its contribution to bearing power is concerned. Under such conditions, an insulating course should be placed first, consisting of fine granular material such as stone screenings or sand. Even hay or straw may be used to cover the soft soil and prevent rutting. This will provide a firm working table upon which to place the crushed stone course, thereby making that layer completely effective.

To recapitulate, it is clear that in the construction of an airport the first consideration should be drainage, which will insure a uniform subgrade support. Second, the base course must be of a material unaffected by weather changes and in itself largely capable of carrying the loads to be imposed. This is sound procedure at any time because, as a rule, it will be the most economical. Under present wartime conditions, however, it becomes mandatory because of the shortage of various manufactured products in many areas and the necessity of conserving transportation facilities. Regardless of the pavement type, whether flexible or rigid, the improvement of the subgrade and placement of proper base courses will permit a minimum section for the surface course.

In general, it has been found that 2 in. of asphalt pavement is about the minimum, when anything thicker than a surface treatment is to be placed. Also, for heavy-duty fields, this surface should be a hot-mix type, preferably a coarse graded asphaltic concrete. On the other hand, there is seldom need for making such an asphalt surface of greater thickness than 5 in. because it is usually more economical to secure any needed additional bearing power through the use of a better foundation, which uses cheaper aggregates. If crushed aggregate is employed for base courses, there is no particular point in utilizing thicknesses greater than 12 in. for even the heaviest loadings, because at depths of more than a foot, a sufficiently high bearing value can be obtained by placing layers of such materials as sand, sandy gravel, slag, or cinders, and selected soils.

The Asphalt Institute therefore recommends that hot asphalt pavements be designed upon the basis of first evaluating local conditions of aggregate and pavement technique, surfacing to range from 2 to 5 in. in depth according to type of foundation materials available. Where the natural subgrade is of high bearing value, such as sand or gravel, the thickness of base and surface can be reduced very markedly. For example, one of the large Army bases has a sandy subgrade many feet thick. A pavement composed of a $4^1/_2$-in. trap-rock base and a $2^1/_2$-in. asphaltic concrete top has proved to be quite adequate. Load-bearing tests on this field indicate a value under the 30-in. plate (which corresponds to a 70,000-lb wheel loading) of over 175 lb per sq in. to produce the 0.2-in. deflection. A deflection of 0.2 in. is taken as critical, but actually is conservative for sand subgrades. The actual service load is about 75 lb per sq in.

There are certain practical considerations which limit the depth of base and surface and which are tied in with construction procedure. Thus, it is not practicable as a rule to place macadam much less than 4 in. thick. Hence the only saving that could have been made in this instance would have been $^1/_2$ in. in thickness. In that particular area the practice of constructing $4^1/_2$-in. macadam bases is so well established that the familiarity of contractor and engineer with such a procedure made it highly desirable not to change. Likewise consider the practical angle. On an area as large as a runway, over a mile long and 200 ft wide, there are bound to be minor settlements no matter how much care is exercised in construction. Hence, if the asphalt surface course is made less than 2 in. thick, there may be high points in the base that would reduce the effective thickness to some extent. For these reasons, 2 in. of asphalt pavement surface and 4 in. of base are generally accepted minimums, even with high-support subgrades. For low-support subgrades, these thicknesses would of course be increased as required.

Some sands of rather uniform grain size have bearing values that cannot be raised above 50 lb without the addition of fine material as a binder. However, to introduce this fine material may change the character of the sand so that it will be adversely affected by frost, particularly if the ground-water level is near the surface, as frequently is the case at seashore locations. It is therefore much better to increase the thickness of the overlying base rather than to run this risk. Under such circumstances, a thickness of as much as 12 in. of macadam frequently may be desirable if cheap stone is available. This design may be advisable for seashore locations because of the possibility of cheap transportation of the crushed stone by water, and for locations where heavy wheel loads are anticipated. This particular situation is mentioned to illustrate some of the factors which the engineer must study thoroughly and weigh carefully before arriving at his final decision.

TENDENCY TO NEGLECT MAINTENANCE DEPLORED

And finally, just a word as to maintenance. The trained highway engineer knows that this begins the day construction ends, in respect to both pavement and drainage. For the first year, on almost any highway, from several hundred to a thousand dollars a mile will be required, to make needed corrections. A large airport may be the equivalent of anywhere from 50 to 100 miles of highway, and the possible annual maintenance expenditure would therefore be from \$20,000 to \$100,000. Rarely is any provision made for work of this kind. Even before the war started, large municipal airport surfaces were expected to be maintained at \$2,000 or \$3,000 a year, and of course steady deterioration was noted in almost every case.

On completion of an airport it should be a matter of general policy to provide a stock pile of patching material; this should amount to several thousand tons of premixed bituminous material. It is desirable to have the construction contractor provide this unless paving plants are available nearby. So long as the mixture is stockpiled, it will not set up, but after placement in thin layers and compaction, hardening is almost immediate.

Frame Buildings for a Western Cantonment

Wooden Structures Designed to Resist Earthquake Stresses

By Don Hull McCreery, M. Am. Soc. C.E.
Chief Engineer, Leeds, Hill, Barnard and Jewett, Los Angeles, Calif.

STANDARD plans for cantonment structures furnished by the Quartermaster Corps have been in use for some time. The unusual conditions at one western camp, however, dictated a redesign of structural framing to provide resistance to earthquake stresses. Diagonal sheeting, plywood gussets, and continuous concrete wall footings were among the changes introduced. Design and erection features of this project are here described by Mr. McCreery.

WITH the tremendous program of cantonment construction that faced the Army at the start of the defense work in 1940, it was fortunate that the Quartermaster Corps had standard plans for the necessary buildings. It was generally anticipated that these buildings would be constructed just as shown on the plans, but there were frequent instances in which it was found advisable to change the plans to fit the requirements of the particular locality in which the cantonment was to be built.

Authority to make such changes was given in the standard form of Architect-Engineer contract for design, wherein it was stated that the Architect-Engineer should "adapt government designs and specifications and standards for buildings and other structures as necessary to meet the requirements of the approved layout of the proposed project . . . ."

Probably the most obvious need for changes in the standard building plans was in areas subject to earthquakes, such as certain parts of the Pacific Coast. Here it was necessary either to add to the standard plans sufficient bracing to strengthen the building frames against horizontal forces, or to redesign features of the buildings to provide resistance to these forces. On one cantonment constructed in an area subject to earthquakes, an opportunity was afforded to study this question during the planning stage. Comparative estimates made as a part of this investigation showed that it was considerably cheaper to redesign the buildings. The engineering and drafting cost for such redesign was, of course, included in the figures used in the comparative estimates.

Failures of frame buildings in earthquakes have shown some of the most vulnerable points to be at the foundation and in the framing immediately above. Therefore, in redesigning the buildings for the cantonment in question, it was considered wise to use the type of foundation and floor system that had given the best results in California—that is, a continuous concrete footing under the exterior walls and pier footings for interior support, with the floor well braced to the footings. Typical sections of this type of foundation are shown in Fig. 1.

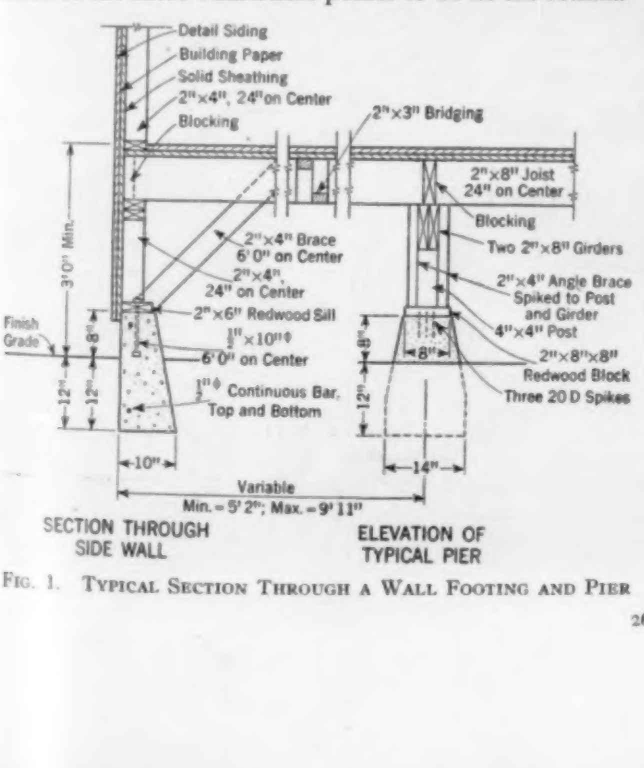
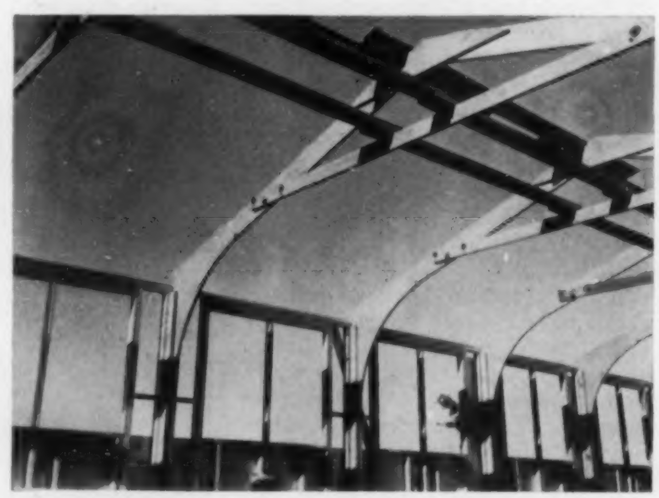


Fig. 1. Typical Section Through a Wall Footing and Pier

In this design the exterior wall footing is continuous around the entire perimeter of the building, and the redwood sill is continuous throughout. The interior pier footings average 6 ft on centers along each girder, but vary somewhat in the different structures, depending on the type, use, and floor load. The span of the joists, and consequently the number of girders, varies according to the width of the building and the interior arrangement—whether a clear-span roof system or interior columns. The 2 by 4-in. cripples on the side walls are held by 2 by 4-in. diagonal braces cut in at all corners and every 25 ft between.

Preventing Damage from Termites

The termite shields that were so noticeable on buildings constructed in the earlier camps are conspicuous by their absence from this design. Experience has shown that the best preventives of termite damage are a thoroughly clean earth surface under the building, a distance of at least 8 in. between the earth and the nearest wood, and good ventilation throughout the space beneath the floor, with ample provision for periodic inspection of this space. It was therefore decided to omit the termite shields in this design and provide the proper number and spacing of vents and crawl holes in the exterior walls. This resulted in a further saving in construction costs



Plywood Gusset Plates Brace a One-Story Frame

FRAMING A TWO-STORY BARRACKS BUILDING

and, as the termite shields had been of galvanized iron, a saving of critical materials. The specifications required the clean-up of the earth beneath the floor.

POINTS NEEDING SPECIAL DESIGN ATTENTION

Experience with frame structures in earthquakes has shown that the roof systems of such buildings, and particularly the connections between the roof systems and their supports, are points needing special attention to provide resistance against horizontal forces. Therefore, in the redesign of the buildings, the roof sheathing was changed from horizontal to diagonal in order that the sheathing and rafters—or, in certain types of buildings, the sheathing and purlins—would act as a diaphragm and carry the horizontal loads to the braced supports and end walls. The end walls were changed to have diagonal sheathing instead of horizontal, as well as diagonal cut-in braces, to enable these walls to carry the horizontal loads to the foundation.

For buildings having a clear span in excess of 29 ft 6 in., the roof was carried on truss and column frames. The frames were designed for horizontal as well as vertical loads and a moment-resistant connection was used at the juncture of truss and column. This was done with knee braces where the truss had insufficient depth at the point of connection. Heavy connections between the column and the foundation were provided in most cases to introduce moment resistance from the footing, with consequent reduction in column moments and section.

On the narrower buildings—those with widths of 25 ft 4 in. and 29 ft 6 in.—the lateral loads, wind and earthquake, were transmitted by the diagonal roof sheathing, acting as a diaphragm, to the end walls, or to interior cross walls wherever possible. These interior walls, when used to transmit horizontal loads to the foundation, were also diagonally sheathed. Where the diaphragm construction was not practical—that is, where the ratio of length to width became excessive, allowing undue deflections in the center of the structure—rigid frames were introduced at intervals, usually 8 to 9 ft, as required to withstand the tributary loads.

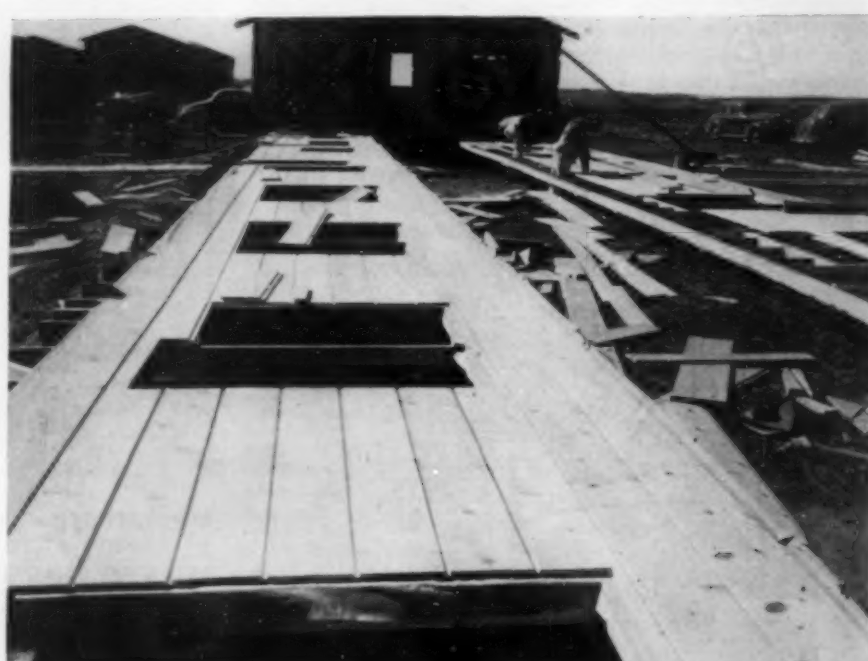
These frames consisted of double-column members enclosing a plywood gusset connected to a trussed rafter system. The gussets were made of Douglas fir plywood 1 in. and $1^{3}/_{8}$ in. thick, the thicker being used where there were no ceiling joists at the plate line. The details worked out nicely with a minimum of connection units, and the construction required very little scabbing. The rafter system and columns were designed as a unit frame to withstand reasonable loading combinations. Between frames the trussed rafters were carried on plates and studs in the conventional manner, the studs taking the vertical loads only.

There were several advantages in this type of bracing, not the least of which was a commendable saving in cost. The fact that the entire bracing frame could be fabricated at a central shop and then transported as a unit to the point of use contributed to the economy. The bents were carried from the fabricating shop to the point of use on flat-bed trucks equipped with a specially built carriage structure. When set up in position on the floor plates, the bents acted as templates for the balance of the roof rafters.

The resulting structure has a clean, clear-cut appearance with more headroom along the walls. Of particular advantage in mess halls and hospital buildings is the freedom from dust-catching surfaces such as the top edge of knee braces. This type of bracing was used in such one-story, clear-space buildings in this cantonment as mess halls, hospital wards, hospital barracks, and some special buildings. The contractor experienced no difficulty in obtaining sufficient plywood to complete the work, and a comparative estimate made by him before the start of construction showed a lower cost for this type of bracing than for knee braces.

SNOW LOAD OMITTED IN ROOF DESIGN

Since the area in which the camp was built is not subject to snow storms, it was considered advisable, in the



END WALL ERECTED WHILE SIDE WALLS ARE BEING FABRICATED ON THE GROUND

interest of economy, to redesign the roof system with less pitch and without the snow load. Wind load was a consideration in this location and a desirable decrease in the total height of the structures resulted from the flatter roofs. The consequent reduction in load permitted smaller column and rafter sections, thereby contributing materially to the saving in the cost of construction without changing radically the appearance of the buildings.

Warehouses with Concrete Firewalls

In the construction of camp buildings in the western area, contractors have generally adopted the practice of building the side and end walls in a horizontal position on the floor and then raising them into place as a unit. All the framing of the wall from floor to plate line is completed, to include the window and door frames, while the wall is on the floor. This has been found to be the cheapest and quickest method of fabrication.

In order that this method may be used on two-story structures, such as barracks and administration buildings, it is necessary that the framework be of the "platform" rather than of the "balloon" type. Therefore, in redesigning the two-story buildings, the "platform" type of framing was used.

Among the larger buildings in a cantonment, the laundry and the sports arena are probably of the most interest to engineers. The laundry is a frame structure 270 ft 6 in. by 210 ft 6 in. in outside dimensions, with a complete boiler plant as a separate and detached building. The laundry is completely equipped with modern machinery to take care of all the washing for 40,000 enlisted men and officers. Since there are approximately 350 employees engaged in the operation of this machinery on each shift, it was necessary that the building contain adequate provision for locker rooms, lunch rooms, wash rooms, and sanitary facilities. It was also essential that sufficient storage space for supplies be included within the building.

LAUNDRY SKYLIGHTED

Requirements for operation of the laundry prohibited interior partitions, except for a small section at one end where the personnel services are located. The roof construction consists of sawtooth framing with skylights over the central portion of the building, surrounded by a band of flat roof on all sides. The spacing and clear height required for the interior columns precluded their use in resisting horizontal forces (except in a secondary degree). The exterior walls were cut by large windows, but when the strength of all pilasters in the long walls was cumulated, it was found to be adequate to resist the imposed lateral loads.

Forces were transferred by tying the sawtooth construction to the flat roof section at the edges and then building the roof with diagonal sheathing and heavy, well-fastened members at each edge to create a flat, deep (20-ft) plate girder of wood. This girder was checked for stress and deflection when transferring the roof load to the widely separated side walls which, in turn, carried the load to the foundations. The sawtooth construction was tied together in both directions to permit the pick-up and transfer of loads to the outside girder. The structural-resistance system was relatively simple and straightforward, the connections again being the major problem, as is usually the case in timber framing. Details were designed and drawn at almost every connection, and nailing was carefully specified so that vital elements in the structural unit would not be left to the judgment of the workmen in the field.

SPORTS ARENA AND AUDITORIUM

The sports arena is a frame building with outside dimensions of 131 ft 3 in. by 181 ft $11^1/_4$ in. There is a covered porch 18 ft 6 in. wide at one end and a heater room 50 ft by 19 ft 6 in. at the other. The main auditorium contains space for basketball courts, boxing ring, and spectators' seats to an estimated capacity of 2,750. This auditorium is 100 ft wide and 180 ft long and is covered with a diamond-grid timber roof framing system. There are no tension rods spanning the auditorium at the roof line, the arch thrust being taken by concrete buttresses. Besides the auditorium, the building contains space for locker rooms, shower rooms, a business office, and storage space for the collapsible bleachers.

Service Club Provided at a Western Camp

This camp illustrates what can be done, when time permits, in the way of designing cantonment buildings for particular locations and for economical construction. Despite the fact that the entire engineering and architectural plans were completed ready for competitive bidding 90 days after the award of the Architect-Engineer contract for design, there was sufficient time to make the studies and changes noted. The bids, being about four million dollars under the War Department estimate for the camp, justified the time and engineering cost expended.

The Design of Shasta Dam

Part I. Preliminary Planning and Choice of Site for World's Highest Overflow Dam

By Kenneth B. Keener, M. Am. Soc. C.E.
Designing Engineer on Dams, U.S. Bureau of Reclamation, Denver, Colo.

In mass of concrete placed, the enormous gravity-type structure to restrain the rushing waters of the Sacramento at Shasta is second only to Grand Coulee. Its size was an important consideration in the choice of type, as is here explained by Mr. Keener. Rising to a height of 602 ft, it creates a lake covering 30,000 acres. This, the most important unit of the Central Valley Project, will reclaim vast areas of rich but arid land in central California.

Two-thirds of the agricultural lands of the entire state of California are located within the drainage basins of the Sacramento and San Joaquin rivers. The confluence of these two rivers, about 50 miles east of San Francisco Bay, forms the delta region where the natural drainage outlet of the Central Valley Project is located. This project, being developed by the Bureau of Reclamation, is correctly termed "multiple purpose," since its completion will provide irrigation for fertile but drought-stricken lands, development of firm power, flood control, navigation possibilities, salinity control of waters in the delta region, industrial and municipal water supplies, and recreational facilities.

As these various services to be rendered by the project greatly influenced the design requirements for its major structure, Shasta Dam, it is desirable to outline them. For example, after reading a brief description of project purposes, one should readily understand why the river-outlet capacities at Shasta Dam are comparatively large. Whatever the purposes or desirable requirements of a project, they are of course influenced and limited to a definite extent by nature; consequently these influences and limitations must be considered in the preparation of the structural designs.

Conditions Influencing the Design

Frequently the natural conditions cannot be completely determined and factors of safety must be used with the known data to insure the safety of a structure beyond reasonable doubt. For instance, it is well known that records of past floods do not alone serve to determine the capacity of a spillway; however, this capacity, assumed on the basis of probabilities of a maximum flood in the life of the dam, greatly affects the design of the structure. As a result, an economic balance is necessary between the required features of a project and the available natural facilities. Since this economic problem of the development of an entire project must be solved with contributions from different individuals and organizations, a final solution is reached with full recognition that it cannot be exact.

The plan for the Central Valley Project (Fig. 1) is based primarily on the natural conditions that obtain in the Sacramento and the San Joaquin River basins. The first has water in greater amounts than is needed for irrigation in its own basin, whereas the second, and the delta region, have definite need of this surplus water.

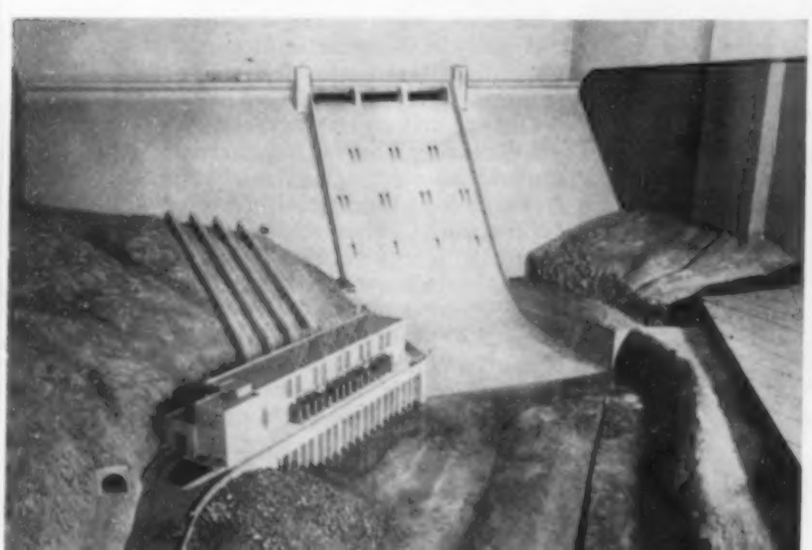
During a period of extraordinary rainfall, cultivation of the fertile areas of the San Joaquin was extended farther and farther so that the requirements for irrigation water were based on nearly the maximum supply which could be expected from the river. As a result of plentiful irrigation over an extensive area during this wet cycle, the ground-water table was raised so that in the following years of drought it could be easily tapped by low-lift pumps to obtain a water supply which was no longer available from the river itself. As the drought continued, however, the pump lifts became higher and higher until pumping became economically prohibitive; and in the lower delta region saline water was all that could be obtained.

This gradual diminution of the fresh water in underground storage resulted in the partial abandonment of inland agricultural areas formerly productive and highly developed. In the delta region, the depletion of the ground water made way for salty bay waters to encroach farther inland so that otherwise rich farm lands ultimately became unproductive. Furthermore, manufacturing plants which depended on large supplies of fresh water were forced to close.

The history of the Sacramento River has been one of devastating floods alternating with periods of drought so that navigation upstream from the city of Sacramento has been intermittent only. A controlled flow of the river would make the reach of about 125 miles between Sacramento and Red Bluff permanently navigable for river boats.

Records for the Sacramento, over a period of 42 years, from 1896 to 1937 inclusive, showed an average yearly runoff near the dam site of 8,101,300 acre-ft, with a maximum of 15,630,000 in 1904 and a minimum of 3,320,000 in 1924. Within this period, the maximum momentary-peak flood of record was 262,000 cu ft per sec, which occurred in December 1937. It is interesting to note, however, that after designs were prepared for Shasta Dam and construction was in progress, a greater maximum momentary-peak flood, reported as 291,000 cu ft per sec, occurred on February 28, 1940. The minimum daily flow is about 2,400 cu ft per sec. The drainage area upstream from Shasta Dam amounts to 6,665 sq miles.

As for the San Joaquin River, its history shows that it has provided an abundant water supply for long cycles



Model of Shasta Dam in Bureau of Reclamation Laboratory at Denver, Colo.

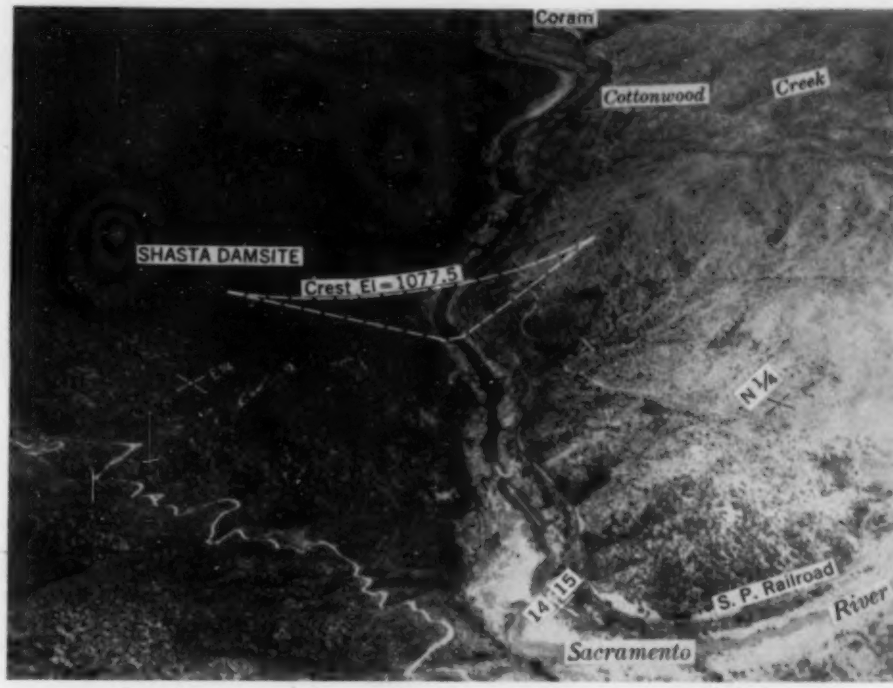


FIG. 2. OBLIQUE VIEW OF SITE FINALLY CHOSEN FOR SHASTA DAM

of years, with occasional damaging floods, interspersed with long periods of low runoff. Records for the San Joaquin over a period of 31 years show an average yearly runoff near Friant Dam of 1,698,300 acre-ft, with a maximum of 3,560,000 in 1911. Its maximum flood of record was 77,200 cu ft per sec, which occurred in December 1937. The minimum daily regulated flow is about 44 cu ft per sec.

The natural conditions described justified the building of the Central Valley Project. Plans for the project provide for gross storage capacities of 4,500,000 acre-ft, in Shasta Reservoir and 520,550 acre-ft in Friant Reservoir, reserving 500,000 acre-ft, comprising the upper 17 ft of depth in the former, and 70,000 acre-ft, comprising the upper 15 ft of depth in the latter, for flood control. The active storage supply at Shasta Reservoir will be released to develop firm power at Shasta Dam, to make the downstream reach of the river navigable, to dilute and replace the saline ground waters of the delta region, and to supply irrigation water for the delta region and the lower San Joaquin basin.

In the delta region, the Contra Costa area in the vicinity of Suisun Bay will be irrigated, as well as supplied with water for domestic purposes, from a 46-mile canal into which water will be pumped in four lifts, totaling 124 ft, from Rock Slough near Knightsen, Calif.

CANALS TO DISTRIBUTE REGULATED FLOW

Now being investigated is the plan for transferring water from the Sacramento River to the lower San Joaquin valley by means of the Delta Cross Channel, which it is proposed will have an ultimate capacity of about 10,000 cu ft per sec. This canal will consist of a series of pump lifts and will terminate in the vicinity of the junction of the San Joaquin and Mokelumne rivers. As these San Joaquin areas will be served with Sacramento River water, the runoff of the San Joaquin River will be used for the area upstream from the outlet end of the Delta Cross Channel.

To provide water for this upstream area, Friant Dam, located about 20 miles northeast of Fresno, is being constructed for purposes of storage and direct diversion, and

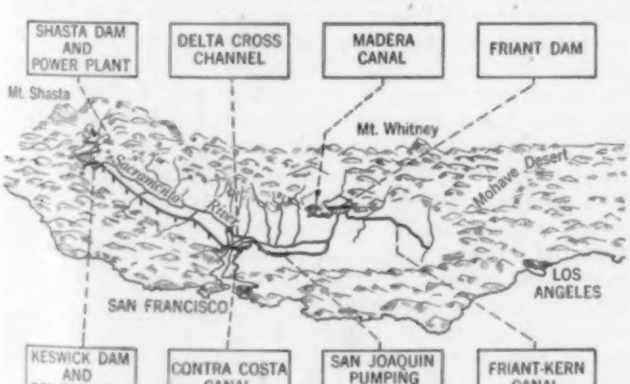


FIG. 1. THE CENTRAL VALLEY PROJECT

flood control. The capacity of the outlet works supplying water for the Madera Canal will be 1,500 cu ft per sec, and the capacity of the outlet serving the Friant-Kern Canal will be 3,500 cu ft per sec. The former canal will transport water 40 miles to the northwest, ending at the Chowchilla River, and the latter canal will extend 160 miles to the south, to the Kern River west of Bakersfield.

Among other features of the project is the Keswick Dam, which is being constructed across the Sacramento River, about 9 miles downstream from Shasta Dam, for the purpose of additional power development, stabilization of river flow, and trapping of migratory fish. An article describing the general features of the Central Valley Project—by Walker R. Young, M. Am. Soc. C.E.—appeared in the September 1939 issue of CIVIL ENGINEERING.

CHOICE OF SHASTA DAM SITE

The present location for Shasta Dam was chosen only after preliminary investigation and consideration of several possible sites, notably the Baird site, on the tributary Pit River 8 miles upstream from Shasta, and the Table Mountain site, on the Sacramento River about 10 miles upstream from Red Bluff. The site chosen for thorough investigation was that finally selected for the dam. This is on the Sacramento River 12 miles upstream from Redding and 5 miles downstream from the mouth of the Pit River (Fig. 2).

A view of the undisturbed site did not indicate that bedrock existed, generally, at reasonable depths, for the greater part of the area was covered with a soil overburden supporting a growth of scattered trees and other plant life. In places, however, some of the most durable rock had reacted more slowly to the natural processes of decay and disintegration into soil and consequently was exposed as ledges. The profile of the natural ground surface, from left to right across the valley along the axis of the dam, started with a 3:1 slope 1,900 ft long, inclining downward to the rounding river-bed channel. From the other side of the channel, which was about 300 ft wide, the profile inclined upward on a 2:1 slope 250 ft

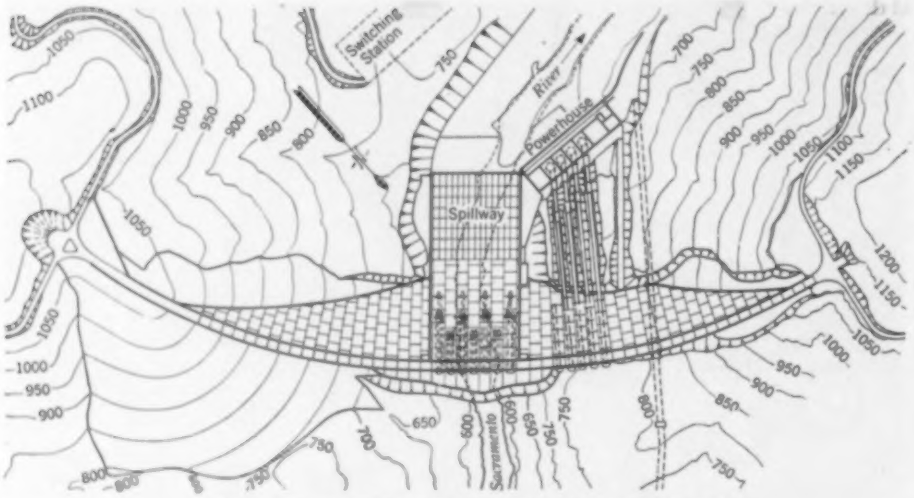


FIG. 3. PLAN VIEW OF SHASTA DAM AND POWER PLANT

long, then flattened to a 10:1 slope 300 ft long. From this point the slope was again 2:1 for 750 ft.

Upon this site in 1924, 1925, and 1930, diamond drilling and tunneling explorations were performed by the State of California. Later, in 1936 and 1937, a final investigation was made by the Bureau of Reclamation not only to determine the adequacy of the foundation but also to obtain the necessary information for the final design of the dam. Throughout the investigations, safety, economy, and the multiple purposes of the proposed structure were considered. Much of the information thus gained was made available for the prospective bidders in the specifications for the construction of the dam. Foundation explorations, completed before the beginning of construction, consisted of 101 small-diameter diamond-drill holes with an aggregate length of 14,495 ft, 3 calyx holes of 3-ft diameter with an aggregate length of 188 ft, 14 tunnels with an aggregate length of 5,732 ft, and 2 shafts with a total length of 183 ft. Among these borings, the deepest diamond-drill hole was 435 ft, and the longest tunnel was 687 ft. Other work included the experimental washing and grouting of seams to secure data for design and construction.

The earliest investigations of the site, which indicated that it was entirely in a single geological formation, the Copley Meta-Andesite, were substantiated by later thorough explorations. This one formation, however, is not uniform throughout the area, doubtless because varied formations of andesitic rock were present before metamorphism occurred. Such variations in structural features are of particular significance for design purposes. Tests made on seven 6-in., and thirty-three $4^1/_2$-in., diameter specimens of foundation rock, taken from various locations and depths, gave an average ultimate compressive strength of 12,050 lb per sq in. The average weight of the rock tested was 175 lb per cu ft.

NO SERIOUS ROCK FAULTS DISCOVERED

Foundation explorations, together with the construction excavations that followed, showed the existence of numerous joints of different classifications, such as faults, crush zones, seams, small fractures, and incipient cracks. No major faults, and none indicating recent movement, were revealed. Some of the joints were open, some filled with broken rock and gouge. Joints wide open at the surface of the rock, narrowed at lower elevations, and as the drills penetrated more deeply, an improved quality of rock was found. Weathering showed in many weakened zones to depths exceeding 250 ft.

Despite numerous faults and joints, the individual rocks, both large and small, were hard, sound, and durable, except in the weathered zones. Thus, with removal of inferior rock and proper treatment of that remaining, the foundation was judged to be adequate to support any type of dam selected.

Materials of construction and shape are the two chief characteristics to be decided on for any dam. Before the final selection, important considerations are the intended purposes, topography of site, geological foundation conditions, economy (including the related availability of construction materials), safety of the structure, and architectural effects. As these considerations are somewhat interrelated and some are more significant than others, no attempt has been made to list them in the order of their importance in the discussion which follows.

Project planning determined a gross reservoir-storage capacity of 4,500,000 acre-ft on the Sacramento River. Of this capacity, the top 500,000 acre-ft would be used primarily for flood control, and a dead storage of 500,000 acre-ft would be maintained to provide a minimum power head of 238 ft. To obtain all this capacity at the Shasta site, the height of the dam would have to be 500 ft above the river bed. Such a height is unprecedented for an earth and rock-fill type. The nearest to it are Mud Mountain Dam, being constructed to a height of about 380 ft above the stream bed; San Gabriel Dam No. 1, built to a height of about 310 ft above the original river bed; and the Anderson Ranch Dam, now being built by the Bureau of Reclamation to a height of about 340 ft above the river bed. Disregarding precedent, however, there appears to be no reason why the required height alone should eliminate an earth and rock-fill type.

SPILLWAY AND OUTLET PROBLEMS

There were other considerations, however. Hydrologic studies, which included consideration of the recorded peak floods and the drainage area, resulted in the requirement of 500,000 acre-ft in the reservoir for flood-control storage. As this large storage space would have an important leveling-off effect on flood peaks, a considerably smaller amount of flow would have to be passed through or over the dam than would be indicated by the size of past floods. After outlet capacities through the dam were determined, there remained 187,000 cu ft per sec as the maximum capacity for the spillway. For periods totaling the greater part of each year, when the reservoir water surface would be lower than any spillway crest, provision had to be made for many outlets to utilize the storage to meet other project demands in addition to those for power. These spillway and outlet requirements would have a major bearing on the selection of type of structure. Although the unusual height to provide the required storage would not preclude the use of the embankment type, the large spillway capacity, together with the numerous outlets for various reservoir heads to serve power and other purposes, pointed to a type that would embrace all these facilities in a single structure, for the sake of simplification and economy.

The shape or topography of the dam site also had to be considered. Such a broad valley, with a ratio of height

to width of about 1:7, would immediately eliminate a single-arch concrete dam. The width of the valley, however, would not prevent consideration of a concrete-gravity type, an earth and rock-fill type, or even of the lighter types of multiple-arch and slab-and-buttress.

FOUNDATION CONSIDERATIONS

Geological conditions also are frequently the determining factor in eliminating consideration of dam types, except the earth and rock-fill embankment. These conditions at the Shasta site are of a nature to permit the construction of any of the usual types, although the preparatory treatment of the foundation, including depth and extent of excavation, would be widely different. For instance, for a concrete dam, the entire foundation area would have to be excavated through overburden and inferior rock to a solid formation. For an embankment type, the overburden would need to be stripped off to a depth of only a few feet to remove vegetation and other objectionable materials, except for one or two deep cutoff trenches which would be excavated through the overburden to bedrock.

In selecting the type of dam, the normal procedure is to make comparative preliminary estimates of cost of those types which are adaptable to the governing natural factors at the site, aside from economy. Quantities and unit prices of the principal materials in place in a structure frequently have a major influence on its total cost. Often suitable materials are not available within economic hauling distance of the site. As a result, the type finally selected may be not nearly so well suited to the site as regards other conditions.

At Shasta, a main-line railroad and a modern highway both ran directly through the site, connecting it with many cement mills in the general vicinity. Deposits of sand and gravel, which by processing could be made suitable for concrete aggregates, were found within a comparatively short distance. Both these conditions were favorable to the choice of a concrete structure. Also, suitable materials for the various zones of an earth and rock-fill dam were available in abundance in the neighborhood. Hence, the possibility of close comparative estimates of cost on the basis of suitable materials for either general type mentioned was apparent. When considering an earth and rock-fill structure for Shasta Dam, however, it was thought that the costs of providing suitable facilities for both overflow spillway and storage release would so greatly affect the total estimated cost that it would be unnecessary to prepare such a cost estimate for this type of dam for the height that was finally established.

STRENGTH AND CAPACITY ADEQUATE

Safety of the structure is of course a consideration of paramount importance both in choosing the type for any site and in preparing the structural designs after the type has been determined. By safety is meant the security of the structure against a failure which would result in the loss of human lives and property. It is almost impossible to conceive of the failure of a structure as large as Shasta, which impounds 4,500,000 acre-ft of water. The damage would be colossal along the well-settled and highly improved banks of the Sacramento River.

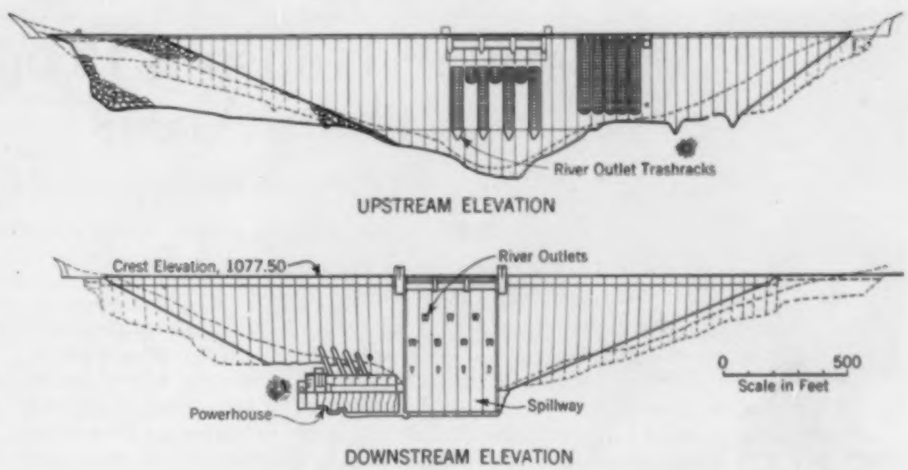


FIG. 4. UPSTREAM AND DOWNSTREAM ELEVATIONS OF DAM

It is in this connection that precedent, if it is to have any place in the design of important engineering structures, should be given full consideration. Inasmuch as no earth and rock-fill, multiple-arch, or slab-and-buttress type has been constructed to a height equaling that of Shasta, it was impossible to judge from precedent what the degree of safety for these types would be.

At the Shasta site, little consideration could be given to architectural effect in determining the design of the structure. It was certain, though, that any type selected would appear majestic because of the unusually large dimensions, and that the appearance could be improved by architectural treatment of certain features.

CONCRETE GRAVITY TYPE SELECTED

The type finally selected was a curved concrete gravity dam, as this was best adapted to all the imposed conditions. Safety and economy were however the primary considerations. As for safety, there was some near precedent of comparable height for this type; and as for economy, both the spillway and many outlets could be made integral with the structure, thus eliminating costly separate structures.

To fit most economically the topography of the rock foundation, the axis was designed with a radius of 2,500 ft, except for the straight overflow spillway section located across the river channel proper. Also, by curving the axis of the dam, an additional element of safety is developed in that a small portion of the total external water load will be transferred horizontally by arch action. At the left end of the dam, where it joins the abutment, an earth and rock-fill type, 525 ft long, with a concrete core wall, was adopted because of its economy and suitability to the geologic foundation conditions. At its junction with the concrete portion of the dam, this embankment is designed to have a maximum height of 115 ft.

Including this length of embankment and a small embankment about 115 ft long joining the right abutment, the total crest length of Shasta Dam will be 3,500 ft. Its maximum height will be 602 ft. A plan of the dam and power plant appears in Fig. 3, and the elevations are shown in Fig. 4.

The planning of additional features of this enormous structure will be described in next month's CIVIL ENGINEERING. The extensive cooling system alone required special consideration to make possible the placing of 6,000,000 cu yd of concrete. Other interesting features to be described are construction joints and cross section, spillway and outlets

A Postwar Housing Program for Urban Areas

Plan for the Economic Rehabilitation of Cities

By Harland Bartholomew, M. Am. Soc. C.E.

City Planner, St. Louis, Mo.

American cities are at the cross-roads, says Mr. Bartholomew. Either an effective policy of rehabilitation will be adopted, or the spread of blighted areas will have increasingly disastrous results. He advocates the formation of citizens' committees to take an interest in this complex problem, and outlines procedures, which, if followed in the post-war period, would strengthen the economy of the American city and improve its character. His complete paper, of which this is an abstract, was read before the City Planning Division at the Society's Annual Meeting in New York.

It is generally agreed that a vast housing program should be undertaken after the war. It would provide employment for an unusually large number of persons in many fields of commercial and industrial enterprise and in several of the professions. What will be the effect of this program on the future economy of American cities?

In the decade of the 1920's, the total number of urban (non-farm) dwelling units constructed annually was approximately 636,000. In the decade of the 1930's, the annual total was approximately 293,000, although a peak of 515,000 was reached in 1939. This again was exceeded in 1940, when the total was 603,000. The earlier program was motivated largely by the then current rapid increase in urban population. The latter program was undertaken despite a relatively small total increase and was accompanied by a substantial but unknown amount of dwelling demolition, including our first slum clearance programs and a large number of voluntary demolitions for purposes of tax reduction.

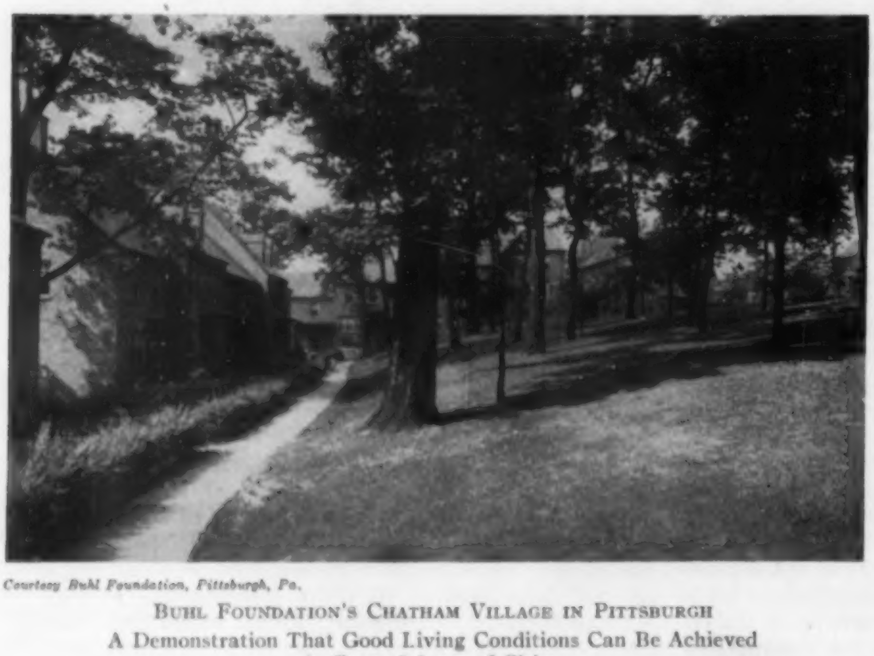
Number of Dwellings Required

The first important consideration in the postwar housing program is the determination of how much new housing is needed in cities (1) to accommodate new population growth and (2) to replace obsolescent units.

One of the forecasts by the National Resources Committee indicated an average annual increase in total population during the 1940's of approximately 856,800. Of this total, the annual urban increase would approximate 504,000. At 3.6 persons per family (the 1940 U.S. Census estimate of number of persons per family of urban population), the number of new dwelling units required would be 140,000 per year.

The war has caused an abnormal increase in the total population of many large and medium sized cities, due to the influx of war workers. Typical is the growth of Wichita, Kans., as shown in Fig. 1. Much of this population has come from smaller cities and towns.

Approximately one-sixth of all dwellings in cities are fifty years or more of age and should be replaced. Despite this fact, however, in the six-year period from 1935 to 1940, when we emerged from the depression and experienced more normal economic conditions, approximately 92% of the new housing was built in suburban areas of our cities. In this six-year period, 2,400,000 non-farm dwelling units were constructed. It is estimated that 75%, or 1,800,000, of these were constructed in urban (and suburban) areas. During this same six-year period, 139,488 dwelling units were completed or under construction in federally aided public housing projects, located for the most part in centrally situated blighted districts or slum areas.



Courtesy Buhl Foundation, Pittsburgh, Pa.

Buhl Foundation's Chatham Village in Pittsburgh

A Demonstration That Good Living Conditions Can Be Achieved in Central Areas of Cities

Had we really learned the significance of the housing problem in cities during the depression years, our subsequent program would have been of a totally different pattern. We would have abandoned traditional practices and adopted new ones. Instead of building 92% of all new city housing in suburban areas, we would have constructed much of it in the central sections of cities by replacing obsolete housing, especially since we were not experiencing much new population growth and hence could scarcely justify new dwelling construction except on a replacement basis.

The total urban population increase between 1930 and 1940, as reflected by 85 identical metropolitan districts, was but 5.7% according to the U.S. Bureau of the Census. Most of the new dwelling construction in this six-year period was not on a replacement basis, but constituted additions to the total supply. The net effect was to enlarge slum areas and blighted districts. Can we direct

the postwar housing program otherwise or shall we continue to follow traditional laissez-faire policy?

There are approximately 28,000,000 non-farm dwelling units in this country today, of which possibly 21,000,000 are in cities and metropolitan districts. It is estimated that one-sixth of these are now fifty years or more of age. Since very few were sufficiently well built to last for a longer period, it would seem advisable to replace many of them within a ten-year postwar period. This would mean an annual construction program of possibly 336,000 dwelling units per year. This should be strictly a replacement program. Obsolete units should be demolished as new ones are erected. There is need for new legislation granting cities adequate power to undertake such demolition.

Of the approximately 17,640,000 non-farm dwelling units less than fifty years of age, some have been constructed in recent years, while others are approaching the fifty-year age limit. If we assume that fifty years is the normal life of a dwelling structure in cities and if in our post-war housing program we adopt an over-all policy of replacement, the 352,800 dwelling units which become obsolete each year should also be replaced as part of the ten-year program.

From the foregoing very general figures, such a program might be set up as follows:

URBAN DWELLING UNITS TO BE BUILT PER YEAR

To accommodate new population growth in cities	140,000
To replace obsolete dwelling units now 50 years or more of age	336,000
To replace dwelling units which will become obsolete each year	352,000
Total annual construction program	828,000

Of the approximately 17,640,000 dwelling units less than fifty years of age, many are in need of substantial repairs and facilities. Such structures are in both slum areas and blighted districts. Those in the blighted districts which are not included in any replacement program should be repaired and brought to a good standard of improvement. Here is a vast opportunity for employment and for business enterprise in the production, distribution, and sale of materials. This is a factor of great significance in any postwar housing program.

THOUSANDS OF SUCH SUBSTANDARD HOUSES CROWD THE CENTRAL AREAS OF MOST CITIES AND SHOULD BE REPLACED

The Real Property Inventory conducted by the Works Progress Administration in something over 200 cities with more than 8,000,000 dwelling units, disclosed that 16% were in need of major repairs or unfit for use; 15% had no indoor flush toilets; 20% were without private bathtubs or showers; and 40% lacked central heating. Many of these structures would be eliminated in any well-considered replacement program, but there would still remain a large number in need of major repairs and improvements.

Division of the city into well-defined neighborhoods, and adoption of properly conceived improvement programs for each, would be an excellent way to set up a postwar housing program.

FIG. 1. POPULATION GROWTH IN WICHITA, KANS.—NOTE DOUBLING SINCE 1940

ECONOMICS OF HOUSING

Very nearly 50% of municipal taxes is borne by residential structures. They occupy 75% or more of the total land in use in each city, if certain other accompanying land uses, such as streets, parks, and institutions in residential areas are included. The economy of every city is thus profoundly affected by its housing. The economic welfare of American cities for the next half century will be determined in large part by the nature of its postwar housing program. This will be our opportunity to build the finest cities in history.

There are some who believe we should break up the large metropolitan city into a series of smaller communities. However, is not our chief dissatisfaction with the present from

A HIGHLY SPECULATIVE TYPE OF REAL ESTATE OPERATION WHICH CREATES NEW PROBLEMS OF BLIGHT IN SUBURBAN AREAS

and character of the American city due almost entirely to the unsatisfactory character of its development, not to faults inherent in its design? Why not introduce open spaces into the present city? They may not now be as large as might be desired, and they may be more expensive than if they had been planned in advance. Surely, however, they will cost far less than any scheme involving a complete change in the structural form of the city. It is futile to speculate upon fanciful designs for a new form of city when we have failed so markedly to achieve unity, economy, and good living conditions within the present relatively simple structure.

Examination of the costs of municipal services in any metropolitan district reveals that the municipality forming the nucleus of the district furnishes a disproportionate share of the total. Of the 15 or 20 major forms of municipal service, the suburban communities generally provide from 5 to 10, and the unincorporated areas none. Furthermore, the suburban population, whether it be 50,000 or 500,000, makes daily use of the services of the central city. How long shall we pursue a form of urban organization such as this, wherein the central city's ability to furnish services is gradually being destroyed through disintegration, while much of the suburban area never has been, and probably never will be, capable of providing adequate services on anything like an economical basis?

PLAN FOR BETTER CITIES

Unquestionably we can plan for the development of our cities so that they will become well ordered, well integrated, and with satisfactory living standards in every part. The prerequisites are (1) thorough understanding of the problem, (2) an adequate plan and program, and (3) an agency sufficiently well equipped, with financial and non-political support to prepare the program, publicize it, and bring about its acceptance and accomplishment.

In each city or metropolitan district there is immediate need for a citizens' organization or council which will be uninfluenced by pressure groups. This organization should be composed of recognized community leaders and representatives from planning agencies, business and industrial interests, social organizations, and labor groups.

If some such procedure as this is not followed, 95% of all post-war housing in American cities will be built in remote suburban areas, thus hastening further disintegration. I say this for two reasons. The first is because it is easier to follow past practices than to change the course of established trends. Secondly, the all-powerful influence of the federal government now supports the speculative process of suburban development through the medium of the Federal Housing Administration. This great governmental agency, which has become virtually a universal mortgage agency, has no announced policy with respect to the development of cities, but since a vast majority of its insured loans, both prior to the war and since, are located in suburban areas, its lack of policy becomes in fact a policy of urban disintegration. The FHA has even insured large multiple-dwelling projects in suburban areas, many of which have defaulted upon their mortgages. Thus the suburban real estate speculator, with the active aid of the federal government, is the controlling factor in shaping our cities. No other effective agency now exists to establish or enforce other policies.

There is only one possible way in which to combat the forces which are destroying our American cities, and that is by vigorous, concerted local citizen action. This is the democratic way.

DATA NEEDED FOR PLANNING

In the preparation of a postwar housing program, the citizens' committee or council should make the following determinations:

1. Probable ten-year population growth.
2. Number of new dwelling units needed to accommodate the added population.
3. Number of obsolete dwelling units.
4. Number of new dwelling units to replace present obsolete units.
5. Number of dwelling units needed to replace those that will become obsolete within the next ten years.
6. Number of dwelling units now in need of repair.
7. Number of dwelling units that will need repair within the next ten years.
8. Number of each type of new dwelling units required to provide adequate housing for the various income groups.
9. Group location throughout the community of the various types of dwelling units comprising the total program.
10. State and local legislation and administrative policies needed to facilitate accomplishment of the program.

Other studies and estimates may be needed, depending on local conditions.

If we accept only partially the theory of replacement and of rehabilitation, many local communities will find that some such distribution of dwelling units within the urban areas, as follows, would provide a sound post-war program:

60% in slum areas
15% in blighted districts
25% in suburban areas

Great difficulties are involved in reversing building trends in cities. Still greater difficulties confront American cities, however, if 95% of all new housing continues to be constructed in suburban areas.

It is imperative that our cities adopt over-all housing policies and programs. Such a policy should have as its objective an equitable distribution of costs of services and proper housing for all income groups. It should not be diverted by the demands or over-zealous endeavors of special-interest groups.

By sound and genuinely comprehensive planning, we can go a long way toward creating fine new American cities within their present framework. Our postwar housing program should not follow past patterns. New plans, new methods, and greatly improved standards must be utilized.

Improved Final Settling Tanks at Bowery Bay

Performance Records Justify Recent Installation in New York Area

By Richard H. Gould, M. Am. Soc. C.E.

Director, Division of Engineering, Department of Public Works, New York City

AVOIDING the conventional design of scraper mechanism for final settling tanks, the installation at the Bowery Bay disposal plant is unique in several respects. Direction of sludge scrapers has been reversed and point of sludge withdrawal relocated. In this paper, which was presented before the Sanitary Engineering Division at the Annual Meeting of the Society in New York, Mr. Gould describes the favorable results obtained and indicates further desirable modifications.

IN the spring of 1942 works for secondary sewage treatment were placed in operation at Bowery Bay in New York City. This new plant included some unusual features and some features that are believed to be unique. As the flows that are being treated are over 80% of the designed capacity of the facilities, it is thought that the results secured so far may be of interest.

The Bowery Bay Sewage Treatment Works has an installed capacity of 40 mgd. The average flow for the period under discussion—that is, May through December 1942—was 32.4 mgd. The major treatment elements of the plant are screens, grit chambers, and primary sedimentation tanks of the usual type, aeration tanks incorporating the "step aeration" principle, final settling tanks of novel design, separate sludge concentration tanks for excess activated sludge, sludge digestion tanks with provisions for the generation of power from the digester gases, and finally, sludge storage tanks used in conjunction with the disposal at sea of sludge not otherwise used.

Some of these units have capacities distinctly below those normally provided. The primary settling tanks provide one-hour detention. If operated in the conventional way with 25% return sludge, the aeration tanks would have a 2.5-hour detention period, while the final settling tanks would have an overflow rate of 1,000 gal per sq ft per day and a detention period of 1.7 hours. The sludge digestion tanks provide for about 2.5 cu ft per capita. The wastes treated may be classified as normal domestic sewage having suspended solids of 197 ppm and a B.O.D. of 145 ppm.

This discussion will deal mainly with the final settling tanks, and more briefly with the aeration tanks, as these two plant elements are closely related—that is, conditions in each are dependent on those in the other. The results secured so far have been somewhat affected by the difficulties inherent in the breaking in of a new plant. We have been short of operating and laboratory personnel and have had to defer some of the things we would have liked to do. Since July 1942, the treatment processes have been forced to carry an undue load from exceptionally heavy decanted liquor from the digestion tanks. This condition has not yet been fully corrected. All things considered, however, the performance has been satisfactory. Operating data for the first eight months are given in Table I.

The aeration tanks at Bowery Bay incorporate the principle of "step aeration" similar to that first established at Tallmans Island, also in New York City. They are of the spiral-flow type with plate diffusers, and each of the two tanks is divided into four passes. Settled sewage may be added in four separate increments while the return activated sludge from the final tanks is admitted at the head end of the first pass of each tank. After the first few weeks of operation, the first pass has been used for the re-aeration of the return sludge and settled sewage has been added in three equal increments at the end of the first, second, and third passes of each tank.

Return sludge is usually held to about 40% of the sewage flow in order to keep the solids concentration in the first pass of the aeration tanks low enough so that dissolved oxygen can be maintained at all times. Generally the suspended solids in the first pass range from 3,000 to 5,000 ppm and those in the final pass from 1,000

View Across Aeration Tanks from Effluent End
Pump and Blower House in Background

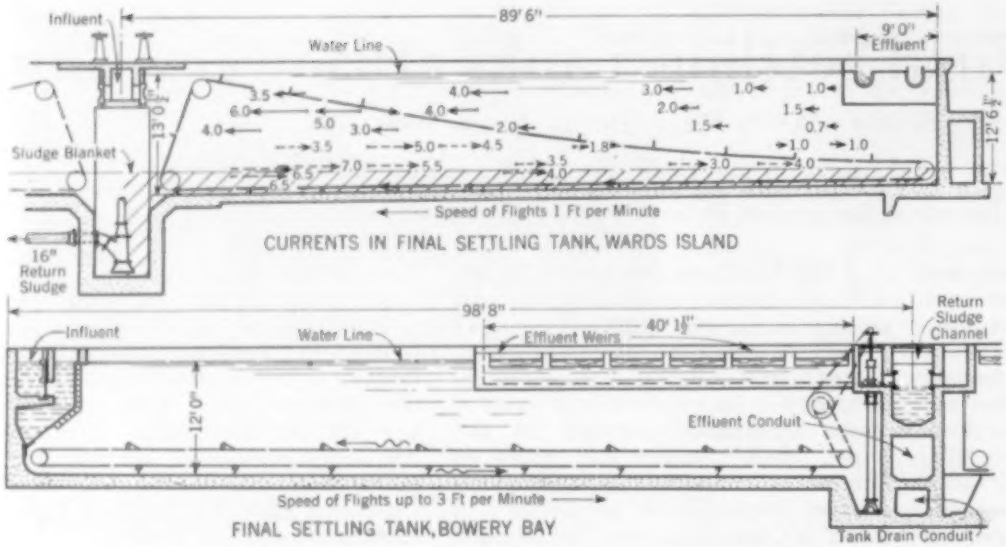


FIG. 1. COMPARISON OF FINAL SETTLING TANK DESIGN AT WARDS ISLAND AND BOWERY BAY DISPOSAL PLANTS

to 1,800 ppm. This results in a detention period of from 3 to 7 days for the sludge in the aeration system. The dissolved oxygen in the tank is held at about 1 ppm in the first pass and about 3 ppm at the end of the fourth pass.

DESIGN OF FINAL SETTLING TANKS

The final settling tanks installed at Bowery Bay are believed to be different from any hitherto used in conjunction with the activated sludge process. They are the result of a reappraisal of the functions of the final settling tank and of the characteristics of the specific liquids and solids to be handled. The usual final settling tank seems to have been the result of various adaptations of the principles developed for primary tanks. The desire to secure maximum concentration of solids seems to persist even though such concentration inevitably means a long period of detention for solids in the tank, with consequent deterioration of the sludge as an aerobic medium. Obviously, considering the function of an aeration tank, it is desirable to maintain activated sludge under aerobic conditions to the maximum possible extent and to shorten the period of sludge detention in the final settling tanks. Eventual concentration of the excess sludge is essential, but this should be done elsewhere than in the final settling tank. The function of this tank should be limited to separating the activated sludge from the aeration tank liquor and returning the sludge rapidly to the aeration tank.

Activated sludge, in contrast to primary sludge, has a tendency to flow along the tank bottom and form a fairly level blanket. Few mechanisms have been developed of sufficient capacity to scrape out all the sludge quickly. To remove this sludge, particularly when of poor settling quality, it is necessary to depend upon hydraulic flow. Circulating currents in final tanks have been noted frequently but their full significance was not apparently realized. Actually it appears that the flocculence and density of this type of sludge are such that in the process of settling it carries with it large volumes of water. This heavier mixture creates a current along the bottom of the tank away from the influent end. On reaching the far end of the tank it is forced upward by the end wall and reverses its direction along the top of the tank. In the course of this flow down the full length of the tank and back, the solids separate from the liquid. The clearest water is therefore usually found at the influent end.

Time-honored methods of removing sludge call for an outlet at the influent end, and removal is assisted by scraper mechanisms that push the sludge in that direction. The fallacy here is that the scraper mechanism is working against the natural direction of flow along the bottom of the tank. Usually a substantial sludge blanket is built up which can be displaced principally by sludge deposited at the far end of the tank. The usual scraper mechanism thus must carry only very old sludge. The sludge blanket above the scraper flights may flow toward the sludge outlet, as a result of sludge withdrawal, but this may be a time-consuming procedure, particularly as regards the sludge at the far end. In many plants under these conditions the average deten-

FINAL TANKS DURING CONSTRUCTION
Before Installation of Weir Plates and Collecting Mechanism

BOWERY BAY FINAL SETTLING TANKS, WITH SCRAPER FLIGHTS
Influent Channel Is at Right and Effluent Weirs at Left

tion period for sludge in the final tanks must run to many hours.

An attempt was made in the Bowery Bay design to correct these conditions by changing the point of sludge withdrawal to the end of the tank opposite the incoming flow. The direction of motion of the sludge-removal mechanism is reversed to correspond with the new location of the sludge outlet and to work in the same direction as the natural flow along the bottom of the tank (Fig. 1).

Operating results so far have vindicated this rather radical departure from usual practice. Good removal of suspended solids has been secured at high overflow rates. The sludge going through the tanks is in a remarkably fresh condition. Tests of dissolved oxygen in the outgoing sludge have shown positive values on numerous occasions and that this sludge usually enters the aeration tank with a dissolved oxygen content of 1 ppm or more.

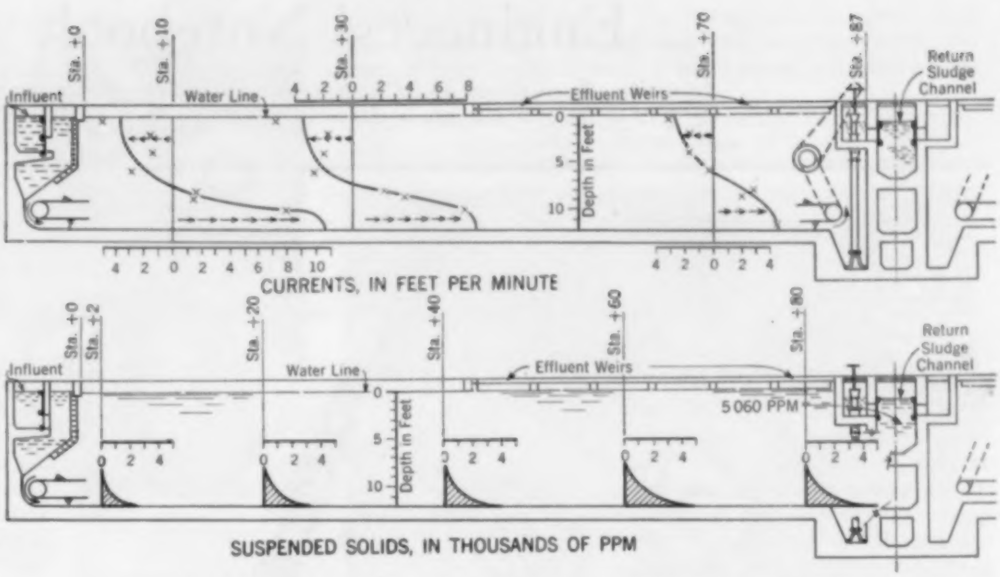


Fig. 2. Flow Characteristics of Bowery Bay Final Settling Tanks

MEASUREMENTS OF CURRENTS IN FINAL TANKS

Several efforts have been made to measure the velocity of currents in the final tanks. Typical results (Fig. 2) show that there is a positive current along the bottom of the tank of from 5 to 10 ft per min. In the original design the speed of the scraper mechanism was increased to 3 ft per min. The velocity of the sludge was still greater than that of the scraper flights, so it is clear that the function of the flights is chiefly limited to the cleaning out of heavy deposits that may lodge on the floor. These flights are more of a hindrance than a help in the major removal problem, but it would not be safe to eliminate them entirely, although their number might well be reduced.

Current tests further indicate that there is a return flow along the top of the tank toward the influent end, as in the older type of final tank. The effluent weirs of the Bowery Bay plant are along the side of the tank for about 40% of the distance from the effluent end. While the results have been satisfactory, our next design will undoubtedly place the effluent channel directly under the influent channel, with the effluent weirs close to the influent end of the tank. The flights of the scraper mechanism are feathered on the return course to the influent end of the tank. It seems apparent that this detail will be unnecessary, provided the return flight is raised so as to travel in the upper half of the tank.

Surveys of the suspended solids in the settling tanks (Fig. 2) disclose that the liquid in the upper three-quarters of the tank is clear and has a suspended solids content of about 10 ppm. Most of the solids are in the bottom foot or two of the tank where the flow is such as to carry them out of the tank within 15 minutes of their entrance. This is the essential advantage of this type of final settling tank.

SAVING IN GROSS TANK CAPACITIES

It is thought that this new type of final settling tank will be of material help in solving some of the more difficult of our activated sludge problems. Its use in combination with the "step aeration" principle evidently permits a substantial saving in gross tank capacities. This conclusion is strengthened by the fact that the tankage provided at Bowery Bay, per million gallons of daily sewage flow, is only 57% of that at the Wards Island plant, which was designed some thirteen years ago. Yet the results of treatment are comparable.

Table I. Average Operating Results by Months, 1942, for Bowery Bay Sewage Treatment Works

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec	Aver.
Suspended solids, ppm:									
Raw	169	210	192	162	229	252	180	183	197
Primary effluent	94	86	124	221	165	170	150	117	141
Final effluent	18	9	10	9	7	14	16	15	12
Aeration effluent	1,020	982	1,640	2,085	1,870	1,590	1,620	1,960	1,600
Return sludge	3,080	2,220	4,080	5,440	4,700	4,040	3,660	4,620	3,980
B.O.D.:									
Raw	147	132	110	108	145	185	165	165	145
Primary effluent	95	73	83	131	106	123	132	116	107
Final effluent	17	13	21	17	10	8	15	16	15
Volatile return sludge, %	70.6	71.4	67.8	61.1	70.2	70.6	70.2	74.0	69.5
Sludge index*	0.40	0.66	0.89	1.4	0.75	0.50	0.43	0.37	0.69
Sewage flow, mgd	32.3	28.5	33.2	34.9	32.8	34.1	31.1	33.2	32.5
Return sludge, %	31	42	40	44	43	44	58	55	45
Aeration detention, hours†	2.8	2.8	2.7	2.6	2.5	2.5	2.4	2.0	2.5
Final tank detention, hours	1.9	1.9	1.9	2.1	1.8	1.5	1.7	1.5	1.8
Final tank overflow, gal per sq ft per day	860	774	915	870	820	960	840	825	858
Air, cu ft per gal	0.50	0.58	0.50	0.49	0.54	0.64	0.72	0.73	0.59

* Donaldson. † Based on conventional aeration tank.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Prefabricated Reinforcing Steel for Tunnel Lining

By L. M. Leedom

Section Construction Engineer, Division of Water, City of Newark, N.J.

EARLY in 1942, the Division of Water, City of Newark, N.J., completed and placed in service a new 48-in. pipe line. At one point it passes under three tracks of the Orange Branch of the Erie Railroad in the northern part of Newark. The crossing is a little more than 100 ft long. Consideration was first given to a plan for a reinforced concrete culvert through which the 48-in. pipe would pass. This required an open trench under the tracks. The estimated cost of timbering to support the tracks was in excess of $11,000.

In an effort to devise a cheaper method of construction, it was finally decided to drive a tunnel under the tracks, using pressed-steel liner plates, estimated to cost about $4,000 in place. This type of construction, with a heavy concrete lining strong enough to support the tracks by itself, received the approval of the railroad engineers.

Completed Cage of Reinforcing Being Lowered Into Shaft

The work was to be done with WPA labor, which precluded any idea of setting up all the reinforcing and forms at one time and pumping or blowing the concrete in place. A moment's reflection showed the impracticability of handling and placing the reinforcing steel in the tunnel, let alone shoveling concrete into forms with a large number of reinforcing bars projecting from them.

It was therefore decided that the lining should be constructed in 5-ft sections, the reinforcing of each section to be independent of that for adjoining sections. Thus it was possible to prefabricate 5-ft sections of reinforcing which could be moved as a unit into the tunnel. Inner and outer rings of $^3/_4$-in. bars were spaced by the $^1/_2$-in. bars, which had little or no value as longitudinal reinforcing for the tunnel lining. A jig was made for assembling and welding the sections of reinforcing. This consisted of eight 4 by 4-in. angles secured to a cross of 6 by 6-in. angles, as shown in an accompanying photograph. The jig was accurately made, although scrap angles were used, and the upright members were spaced to give the exact diameter for the hoops.

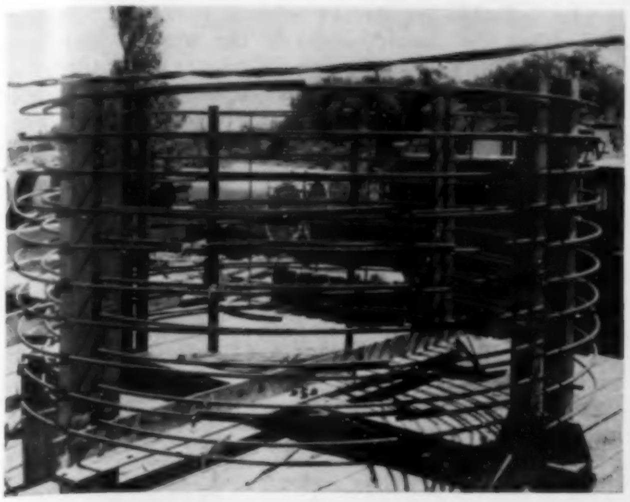
The rods were curved to the proper radius by running them through a portable power roll, and a lap of 6 in. was provided for the welded connection. The 30-ft bars used for the inside hoops made a somewhat longer splice, but the possible saving did not justify the cost of cutting the bars to exact length. The curved hoops were placed in an assembling jig which assured an exactly uniform diameter, and the ends were clamped and welded. Two $^3/_{16}$-in. fillet welds, 4 in. long, one on each side of the bars, were calculated to equal the breaking strength of the $^3/_4$-in. bars. Subsequent laboratory tests showed this to be true.

Welded hoops were then assembled on the jig. Spacing templates, made of 2 by 2-in. angles, prevented sagging of the hoops while 24 half-inch spacer bars were welded in position. Lattice bars were bent on a plate with removable pins to fit the space between the inner and outer hoops. The plate and removable pins insured uniformly accurate results. Twelve lattice bars were then welded in position, completing the reinforcing "cage."

Supporting pins in the jig were then withdrawn and the "cage" easily lifted off the jig with a truck crane. Four of the eight upright angles of the jig had been made removable, in case the cage was hard to remove, but no trouble was experienced as the cages were all uniform and decidedly rigid.

In handling, the cages showed remarkable symmetry and lack of deformation despite the fact that they were sometimes supported from only one side and weighed more than a ton apiece. Spacer bars were placed on the

Welding Hoop of Reinforcing for Tunnel Lining Concrete



Jig for Assembling and Welding a 5-Ft Section of Reinforcing

inner surface of the cage to facilitate placing the concreting forms and on the outer surface to prevent the hoops from fouling the upturned edges of the liner plates of the tunnel.

Cages were lowered into the tunnel and then pulled to the far end with a hand winch. To prevent jamming on the liner plates, six removable skids were used on the cages.

As each cage was put in position, a sectional form was placed inside it. Precast concrete spacer-blocks were used to insure proper concentric spacing of the cage and the form with relation to the tunnel lining. The form was held in place with trench screw-jacks; runways were then placed; and the concrete was wheeled in and shoveled into the end of the form, with no projecting bars to interfere. A very stiff concrete was used and worked into position with a mechanical vibrator operated by compressed air.

The work was in charge of the writer as section construction engineer for the Division of Water. He conceived the idea of the prefabricated cages for this tunnel and also designed the jigs, welding, and concrete forms used on the work. William G. Banks, M. Am. Soc. C.E., was the division engineer and the late James W. Costello, chief engineer. This is condensed from a paper which received an award in the recent competition of the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio.

Placing Concrete in a 5-Ft Section of Forms

Fixed-End Moments Simplified by Calculator

By G. Clinton Brookhart, Jun. Am. Soc. C.E.

With Modjeski and Masters, Consulting Engineers, Harrisburg, Pa.

Fixed-end moments for various loadings may be conveniently determined with the aid of the chart shown in Fig. 1. As it is necessary to use a straightedge with the chart, the author has found it advantageous to mount the scales on a rule with a movable vertical indicator, which thus resembles a slide rule in appearance. With the aid of such a calculator, fixed-end moments for concentrated, uniform, and uniformly varying loads, full or partial, may be determined rapidly.

To obtain the fixed-end moment at the left support, designated by M_FL, for a concentrated load, the indicator is placed at a value of k, representing the relative position of the load on the span. A coefficient is read on the M_FL scale. This coefficient when multiplied by WL (W equals the intensity of the load and L the span length of the beam) gives the fixed-end moment at the left support. It is important to note that the concentrated-load coefficients increase up to a certain point, then decrease. As these coefficients are actually influence values, the ordinate is maximum for $k = {}^1/_3$ for the fixed-end moment at the left, and $k = {}^2/_3$ for the fixed-end moment at the right. This coefficient is actually a repeating decimal ($0.148148+ = {}^4/_{27}$) and is indicated by 0.1481+ on the chart.

In determining the fixed-end moments for uniform or uniformly varying loads, kL represents the limit of the

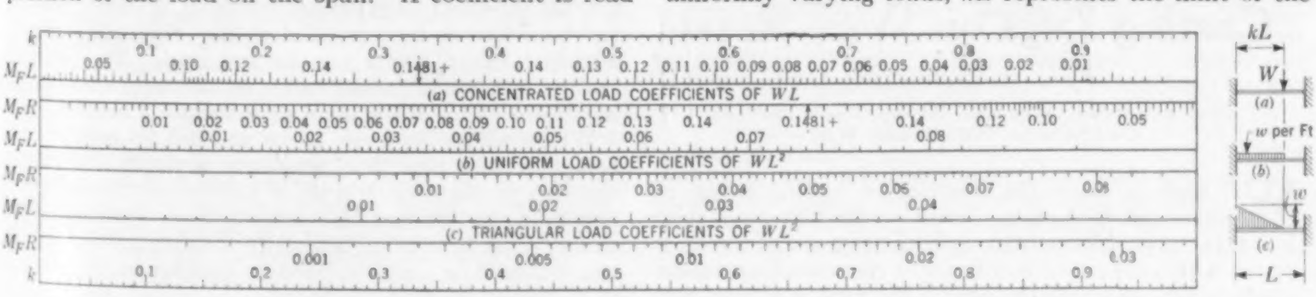
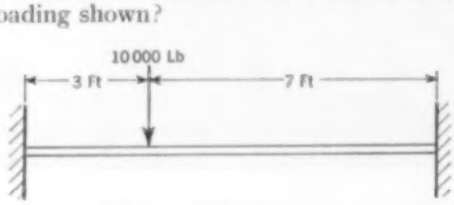


Fig. 1. Chart for Determining Fixed-End Moments

load and is measured from the left support. The indicator is placed at the proper value of k, and a coefficient is read on the M_FL and M_FR scales for the particular loading. The coefficient, when multiplied by wL^2, gives the moments at the respective supports (w is the load per unit of length in the case of a uniform load, or the intensity of the load at the left support in the case of a uniformly varying load).

The following specific examples are sufficient to illustrate the simplicity with which the chart works. A straightedge may be used vertically on Fig. 1 as an indicator. Besides the applications given, it will be evident that the chart is in reality an influence graph, permitting the rapid drawing of influence lines, and from those the quick determination of load location to produce maximum fixed-end moments. In the examples, all the underlined figures are read directly from the chart. For convenience all span lengths are taken as 10 ft.

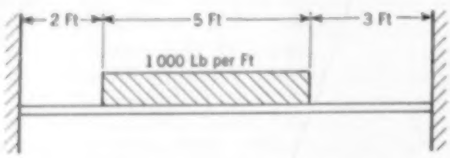
Problem 1: What are the fixed-end moments for the loading shown?



$k = \frac{3}{10} = 0.3$

$$M_FL = \underline{0.1470}\,(10{,}000)\,(10) = 14{,}700 \text{ ft-lb}$$
$$M_FR = \underline{0.0630}\,(10{,}000)\,(10) = 6{,}300 \text{ ft-lb}$$

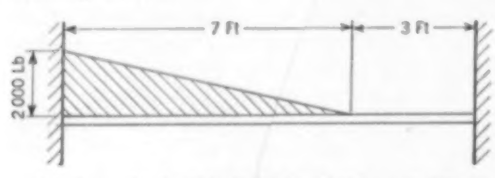
Problem 2: What are the fixed-end moments for the loading shown?



It is to be noted that in this example the moments from a 2-ft loading are subtracted from those for a 7-ft loading.

$$M_FL = (\underline{0.0763} - \underline{0.0150})\,(1{,}000)\,(10)^2 = 6{,}130 \text{ ft-lb}$$
$$M_FR = (\underline{0.0543} - \underline{0.0023})\,(1{,}000)\,(10)^2 = 5{,}200 \text{ ft-lb}$$

Problem 3: What are the fixed-end moments for the loading shown?



$k = \frac{7}{10} = 0.7$

$$M_FL = (\underline{0.0365})\,(2{,}000)\,(10)^2 = 7{,}300 \text{ ft-lb}$$
$$M_FR = (\underline{0.0166})\,(2{,}000)\,(10)^2 = 3{,}320 \text{ ft-lb}$$

Casting Lugs on Wire Rope

By C. R. HOCHMUTH

ASSISTANT WORKS MANAGER, KEARNEY AND TRECKER CORPORATION, MILWAUKEE, WIS.

WE have adopted the practice of casting a lug of solder onto the ends of most of the wire ropes used in our factory. The only exceptions are some of the hoist ropes, which are ended in a basket-type socket, and some of the slings, in which the end of the rope is spliced into the rope body to form an eye or bight.

The soldered lug serves several purposes: First it eliminates the exposed ends of the wires, which are a source of injury and infection to riggers and others handling the rope. Second, it serves as a means for readily attaching hoist ropes to the drums of overhead traveling cranes. Third, where ropes are fastened by clips, the lug on the rope end provides an additional safety feature, for should slippage occur, the last clip will catch the lug.

POURING HARD SOLDER TO FORM LUG ON END OF STEEL ROPE

Because of its ease of handling, resistance to fatigue, and lack of tendency to fly apart, preformed rope is being used throughout our plant for crane and hoist ropes and for many of our slings. Since this rope requires no seizing at the ends to hold the strands in position, it lends itself better to the casting of the solder lugs. For this purpose we have made some split molds of steel, similar to the one shown in the accompanying photograph. These molds are provided for all the sizes of rope we use. The two sections of each mold are held together by means of two screws passing through one section of the mold and into the other section. The mold shown in the sketch will accommodate three sizes of rope, each size being stamped on the mold by means of punches.

To prepare the end of the rope, the strands are unlayed for about an inch and the hemp center is cut back the same distance. The unlayed strands are then cleaned of lubricant and grime by dipping them into a half-and-half solution of commercial muriatic acid and water.

LUGS KEEP ROPE FROM SLIPPING THROUGH CLAMPS

The rope should not be dipped so deep that the acid will reach the hemp center. The strands are then tinned by dipping them into molten solder. It may be necessary to dip in acid and solder several times before a good tinning job is obtained. When the strands are bunched together they can be passed through the bottom of the mold. They are then spread apart, and hard solder is poured into the mold. After the solder cools, the screws holding the mold together are removed, allowing the two mold sections to be separated so that the rope with the attached lug of solder can be removed. To eliminate sharp edges, which might cause scratches or cuts on the hands, the edges of the lug are filed slightly round.

Where solder lugs are to be applied to ordinary, or non-preformed rope, it is necessary to apply a seizing of soft wire to the rope at a point just below the bottom of the mold, to prevent the strands from raveling. The seizing must be applied before the strands are opened up, and it should be supplemented by another seizing an inch or so below the first. After the lug is cast, the seizings may be removed.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Herschel or Venturi?

To the Editor: To anyone familiar with hydraulics, it must be evident that Manual 25 on "Hydraulic Models" is an important contribution and one which will be frequently used by engineers and teachers in determining, by proper construction of dimensionally similar models, the performance of many complex structures. I do feel, however, that an injustice has been done to one of our Past-Presidents and Honorary Members, Clemens Herschel, by omitting any reference to him or to his great achievement in the invention of the Venturi Meter.

It is not true that Venturi "gave rise to what later became the Venturi Meter"; it is quite apparent that he never even dreamed there was any relation between rate of flow and the curious difference in pressure that he observed between the large and small ends of a cone discharging water. One might as well say that Bernouilli was the father of the Venturi Meter. Herschel simply was overgenerous (as he himself later intimated) in naming his device a "Venturi Meter"; it should have been called the "Herschel Meter."

We have to go no further than to the files of our own Society to support these observations. For instance, in Proceedings for April 1930, there is the following statement: "One particularly significant feature in all this was the innate generosity of the man—or perhaps it was merely modesty—in that he named his epochal discovery after an Italian engineer who might otherwise have remained more or less obscure. Certainly it has almost seemed true of latter years that it has been Herschel's meter which has added luster to the fame of Venturi rather than the reverse relationship."

In his memoir (Transactions, 1931), we read that "Clemens Herschel became 'the man who made Venturi famous.'" There we find also a summary of the contributions of this internationally known engineer to the science of hydraulics.

I hope proper recognition will be given to Mr. Herschel in any future editions of Manual 25.

Charles G. Richardson, M. Am. Soc. C.E.

Providence, R.I.

The Gumbel Method of Estimating Flood Frequencies

To the Editor: In the February issue Professor Powell has assumed that the best method of calculating flood frequencies can be no more than an aid to judgment. His final criterion of methods—that is, "...of two methods that may seem equally sound, the one that tends to give the larger values would appear to be the safer"—should be scrutinized. Whether such a criterion is acceptable should depend on the use to which the frequency calculations are to be put.

If we use probabilities not for design purposes but for economic computations, we seek middle-of-the-road values rather than the maximum envelope values indicated by Professor Powell's criterion. In developing an economic analysis of possible projects, the following steps suggest themselves: (1) Determine design flood by envelope, or "rational," methods; (2) design structure tentatively; and (3) apply a probability method to the economic analysis of the justification of that structure.

It would be appropriate and convenient to use the hydrometeorological method to determine the maximum probable flood and then to use that maximum probable flood as the limiting flood in the application of the Slade method. That would eliminate a defect of the Slade method. Those who prefer to use a recurrence-interval approach to the economic analysis may find that the Gumbel method, discussed by Professor Powell, applied on that basis, gives results comparable to the Slade ("exceedance") method. The precise differences between benefits calculated by the two methods might well be made the subject of a separate brief inquiry. At present, the engineer considering the Gumbel method for use in economic studies is faced with the question of whether to use the data developed from the curve on a recurrence or an exceedance basis.

The writer has used the 1875–1931 record for the Tennessee River at Chattanooga as a basis for comparing probability curves developed by the Slade, Gumbel, and Fuller best-fit methods. The Gumbel curve follows the Fuller method curve very closely in shape, but with slightly lower values. Both the Gumbel curve and the Fuller method curve give values decidedly above those given by the Slade curve, and both are asymtotic to a markedly less degree than the Slade curve, thus raising a question as to whether the Gumbel curve is sensitive to a probable physical limit of flood magnitude.

The Gumbel method appears to possess the following advantages: (1) Computations are relatively easy and few; (2) it requires no arbitrary assumption of limits as do some other methods; and (3) the straight-line relationships discussed by Professor Powell lend themselves to easy graphical solution of data.

Its disadvantages include the fact that the Gumbel method curve does not approach a limit nearly as definitely as does the Slade curve. Also, the results it gives are apparently high as compared to the Slade method, and the "larger values" are undesirable for use in economic studies.

The writer reaches the following conclusions:

1. The hydrometeorological, or envelope, methods are superior for use in design; here maximum values are desired.
2. A probability analysis is essential to a competent appraisal of project justification; here average values are desired.
3. Until and unless it is shown that the results given by the Slade method and the Gumbel method differ little when translated into economic terms, consideration may well be given to using the Slade method in such probability analyses, the maximum limiting flood for the Slade method to be estimated on the basis of hydrometeorological, or envelope, methods.
4. The Gumbel method should be the subject of further comparative studies, since its advantages over other methods will be material, provided the comparative reasonableness of its results can be demonstrated.

Reginald C. Price, Assoc. M. Am. Soc. C.E.

Silver Spring, Md.

Engineer Has New Opportunities for Cultural Improvement

To the Editor: From "the hilltop of life," Dean Cooley views the scene of technical education in this country in his article in the April issue. Of course he stands on solid ground in emphasizing the cultural background of engineering training. But is it necessary for students of engineering to be deprived of the more liberal studies, simply because the college curriculum does not provide for them?

During the past decade there have been developments in many fields of art that may more than make up for the losses Dean Cooley deplores. Several radio programs, for example, furnish the mental stimulus to be obtained from the classics. The writer mentions specifically, "Town Meeting of the Air," "Chicago Round Table," "Invitation to Learning," and the factual portions of "Information Please." Then, too, the large public art museums and the increasing opportunities for listening to good music must be marked up on the asset side of our cultural ledger.

In this age, when substitutes are found to do the work of materials more commonly employed, and in so many cases are found to perform it even more satisfactorily, we may well accustom ourselves to the changes that occur in the sphere of culture. Some changes, to be sure, will not be so desirable. But through the years the field of education must gain by the adoption of selective cultural substitutes.

J. C. Holman, M. Am. Soc. C.E.

Flushing, N.Y.

Confusion in Time Standards

TO THE EDITOR: It is my opinion that the item, "Time Standards for Hydrologic Data," on page 195 of the April issue, is as "clear as mud." The article purports to tell whether the various federal agencies publishing hydrologic data use War Time or Standard Time.

Actually, War Time and Standard Time are identical. Or, more exactly, "War Time" is a misnomer for what is properly called "Standard Time." The law is very clear on the matter: "Beginning at 2 o'clock antemeridian of the twentieth day after the date of enactment of this Act, the Standard Time of each zone established pursuant to the Act...approved March 19, 1918, as amended, shall be advanced one hour."

That is, at that moment "Standard Time" became one hour later than it was. So far as I know, it was not until after the law was passed that the name "War Time" was invented. That would have been all right if it had been made clear that it was a name for a different kind of Standard Time, but the supposition that "Standard Time" was the same as ever soon gained wide credence. For example, the article in question started by mentioning a "change" from Standard to War Time.

Now, if everyone agreed to call Standard Time "War Time" and to call the time one hour slower than standard time "Standard Time," there would be no confusion. But such is by no means the case. Most railroad time-tables are given in "Standard Time," meaning thereby the legal standard time, which is "War Time." (More exactly, I find four ways of designating time in time-tables: "Eastern Standard Time," "Eastern War Time," "Eastern War Standard Time," and "Eastern Time!") Consequently, the phrase, "Standard Time," means exactly nothing until you find out what it means; and if you have to get a definition of it, it is better to avoid it altogether.

When it is necessary to mention the two kinds of time together, the only way that would be perfectly clear would be to say "War Time," and "War Time minus one hour."

H. HERBERT HOWE

Falls Church, Va.

Timber Not a Fire Hazard

DEAR SIR: I was interested in the article on "Conservation of Critical Materials" by Messrs. Hill and Zackrison, in the February issue, and in the subsequent discussion of that article.

I do not agree with the statement that "...fire protection depends upon the combustibility of the structure and its contents," nor that the substitution of wood for non-combustible building materials "...naturally results in an increased fire hazard...." Wood, of and by itself, does not suddenly burst into flame, as such expressions might indicate. The essential hazard is represented by the contents, and some carelessness, accident, or plain sabotage may be the cause of fire. When fire occurs, either a combustible or a non-combustible metal framing may be rendered useless in a short time, since unprotected metal readily loses strength under normal fire temperatures. If the non-combustible building material used is not so readily affected by fire temperature, or if the framing is of heavy timber which loses strength only in relation to rate of actual charring, structural stability is retained for a time at least, and opportunity to combat fire is assured.

The sprinkler record assures about 98% control of fire in contents, eliminates argument as to building material used, and more important, conserves precious war materials. Where time or limitations of material do not permit sprinkler installations, division of buildings of large area by fire-division walls with controlled openings assures reduction of loss, and is equally effective in protection of building contents. When fire occurs in the contents and gets beyond control, both the wood building and the usually non-combustible one involving unprotected metal may become a total loss. However, the time-stability of the wood building can prove most important in loss reduction by permitting play of hose streams into the interior of the building.

J. E. MACKIE, Assoc. M. Am. Soc. C.E.
Western Manager, National Lumber Manufacturers Association

San Francisco, Calif.

Pan-American Engineering Relations

DEAR SIR: Possibilities for American enterprise in Latin America have been greatly expanded. It therefore becomes increasingly important to attain a better understanding of these neighboring engineers, and of their working methods.

Ordered not to "waste time," American engineers all too frequently proceed according to schedules carefully related to standard American practice. Subsequently some equipment or parts may fail to arrive on time; some minor local law or week-long "official" fiesta may cause serious delays and expenditures. Frantic telegrams to the home office cannot help; only the ability to deal intelligently with local conditions can win.

Cooperation of the native professionals and laborers should be invited and secured. This is in the interest of immediate gain, also with an eye to future improved relations. Generally very capable local engineers are available, but they have to be sought out. Their gracious politeness is often taken for timidity by their northern neighbors, who have the reputation south of the border as an efficient, but rather noisy bunch of roughnecks. From the average Latin engineer who leans toward an intellectual and scholarly pattern, the colleague from the North can gain much technically and in friendship, by respectful friendliness and tact rather than slap-happy he-man joking. It is no fantastic exaggeration to say that a good old Bronx cheer badly timed may prove fatal for business as well as to the cheerer. A careless or even affectionate American expression has been understood by the addressee in its literal translation, as an unpardonable insult, and promptly caused the death of the addresser.

I mention this extreme example only to stress that human beings, created equal, have developed many group characteristics, which it would be foolish to deny and very impractical to ignore in engineering planning. Remember, our Southern friends' claim for human, personal dignity is worthy of our respect, and their response to honest efforts to understand them is most generous and valuable. Every faltering effort to use their own language is met with eager helpfulness almost as if it were a compliment.

The local engineers, having a knowledge of working methods and equipment, are of greatest value. I have seen the latest type of road equipment brought in at enormous cost for a rush job, only to remain useless for over six months, bogged down by tropical rains and seriously damaged from heat and dampness, while the road was being built, economically and at surprising speed, by a local contractor with nothing but inexpensive hand labor. Knowledge of local conditions would have averted such a situation.

However, such understanding can be gained only by long experience and sincere efforts to understand psychological attitudes. Along some mountain valleys you find tall, strong, and amiable Indian workers—willing, but completely ignorant of how to handle any tool more complicated than pick, shovel, and machete. Again, in coastal malarial areas there are mixed-race laborers, who cannot be influenced to overcome a strong desire to park themselves anytime in a nice shady spot, rush or no rush. When a construction superintendent finds that he may have to put three little men to handle one heavy-type pneumatic jackhammer, he has to hold his tongue and not place any unjust blame on individuals, who are often extremely sensitive about their physical handicaps and lack of experience. But it is pleasantly surprising to find what results can be gained through firm, honest and considerate dealing with them.

Granted that the local method may not be the most efficient, it is still better than the loss and confusion caused by changing an old well-established practice into something new. To put too heavy tools in the hands of slightly built workers is naturally an error that somebody will pay for.

The importance of knowing Spanish or Portuguese is obvious, but cannot be overemphasized. It is encouraging for future Pan-American engineering cooperation that interest in such study has increased enormously in the United States.

It all boils down to the realization of the purely practical value of understanding "the other fellow" and to willingness to cooperate and compromise to mutual benefit. The right and freedom to do so seems to be pretty much what The Big Fight is all about.

L. E. RETTIG, Assoc. M. Am. Soc. C.E.

New York, N.Y.

Sixtieth Anniversary of Brooklyn Bridge

To the Editor: It has occurred to me that on the sixtieth anniversary of the completion of the Brooklyn Bridge, my reflections on the many years that I have been inspector of steel and bridge inspector-in-charge of construction, repair, and maintenance of this bridge, would be of interest to many readers of Civil Engineering.

On May 24, 1883, the Brooklyn Bridge was officially opened to traffic when Chester A. Arthur, President of the United States, cut the ribbon on the south roadway at the center of this span. Likewise, on May 24, 1933, the Golden Jubilee Anniversary, Mayor John P. O'Brien, also cut a ribbon stretched across the roadway. Now again, on May 24, 1943, after sixty years of service, surely it would be very proper to celebrate another anniversary.

This first bridge across New York's busy East River rears its mighty towers above shipping from every free port in the world. Its age-defying cables make an impressive silhouette against the sky. Long regarded as the eighth wonder of the world, and still famous, the bridge continues as a vitally important link between lower Manhattan and Brooklyn.

Theodore Belzner, Affiliate Am. Soc. C.E.

Brooklyn, N.Y.

Engineers Functioning in Civilian Defense Set-Up

Dear Sir: Engineers who are serving in the water branch of civilian defense may be interested in the operational set-up of a Civilian Emergency Squad with which I am familiar. This squad will not only aid the regular crews of the local water company in making repairs following a bombing, but will also make shut-offs should the regular crews be overtaxed.

The noteworthy feature in the making of shut-offs is the fact that the gate valves requiring closing have been predetermined for every possible water-main break in the district. Uncertainty as to who would be available in an emergency led to an attempt to train every member of the squad in every duty pertaining to shut-offs. However, since it was found that the layman could not be depended upon to take the map of the distributing system and determine the proper valves for closing, predetermination appeared the best solution.

The gates to be closed were determined for each possible incident and recorded on incident sheets, together with the proper order of closing, the size of the gate, and the reference numbers to the sketches of valve locations. The next valves along the lines were also noted down, against the chance that any of the others might be found out of commission. In addition, the best route to the break from the control center, from which the squad operates, was entered on the sheet. Each incident sheet was given a number and placed in a file in order, and an alphabetical index was compiled. Thus if a bombing comes, the proper sheet for any water-main break can be picked from the file quickly and the squad promptly dispatched.

Equipment for making shut-offs consists of gate keys, shovel, pick, book of valve-location sketches, 100-ft metallic tape, hammer, screw-driver, lumber crayon, and flash-lights. The small items are kept ready in a suitcase. The actual locating of the gates in the field is accomplished by the tape from the reference points given on the valve-location sketches.

The squad is in the district known as the North Merrick Protection Unit, in Nassau County, N.Y. The water system is owned and operated by the New York Water Service Corporation, of which Mr. James H. Chenery is superintendent. Through his efforts the company supplied the squad with the necessary sketches of valve locations, a map of the distribution system, and gate keys. Mr. Chenery also gave valuable assistance in the training of the squad in the field. The writer listed the incidents, of which there are approximately 375, and determined the gates that must be closed for each.

Lathrop C. Pope, M. Am. Soc. C.E.
Instructor in Civil Engineering,
School of Technology, College of the City of New York

Merrick, N.Y.

Comments on Regrading of Society Membership

Dear Sir: In regard to the discussion on regrading of Society membership, in the May issue, I would like to say that the present system of classification has seemed quite satisfactory to me, and I can see no particular reason to change it. The meaning and significance of the various grades are well understood in the profession. The term "Master Engineer" is as objectionable as the term "Fellow" that was proposed some years ago and voted down by the members.

If any change at all is made, I think the grade of Associate Member should be abolished, leaving Juniors, Members, Honorary Members, and Affiliates. There are many Associate Members now qualified to be Members, who never bother to apply for a transfer to the higher grade.

Lynn Crandall, M. Am. Soc. C.E.

Idaho Falls, Idaho

Forum on Professional Relations

Conducted Column of Hypothetical Questions with Answers by Dr. Mead

For a number of months Dr. Mead has been answering questions on engineering ethics in these columns. In the current issue Dr. Mead gives his answer to Question No. 9, which was announced in the April issue. The question states that, "A young engineer through carelessness damages a transit which he was using on certain work for the state. The transit was repaired at state expense. The work on which this transit was used was delayed by the action, and the engineer in charge was obliged to make a trip to the state capital in order to secure the repair of the transit. Was the engineer justified in taking $25 offered to him by the young engineer who had caused the damage?"

Any expense caused by the carelessness of an individual should be paid by the individual to his employer, whether the employer be an individual, a corporation, or the public.

If the money offered to the engineer in charge was intended to be used directly for a part of the expense caused by the young engineer's carelessness, and was taken for that purpose, the engineer was fully justified in accepting the same. However, if the payment of the $25 to the engineer in charge was personal and was intended to induce him not to report the accident to state officials, both its offer and acceptance would savor of bribery and would be unethical.

D. W. Mead, Past-President and Honorary Member, Am. Soc. C.E.

Madison, Wis.

The questions on ethics given and answered in this column have hitherto been questions propounded by students in the writer's classes at the University of Wisconsin, while he was teaching the subject of engineering relations. The following question has been submitted by a member of the Society interested in the column, who, however, has asked that his name be withheld. This question is common to every large office and should therefore be of general interest. It is hoped that it may lead to some discussion by practicing engineers and readers of this column. The writers' names will be held in confidence if so desired. Next in sequence, for study and written discussion by members until July 5, with answers in the August issue, will be the following:

Question No. 11: *The chief designing engineer of a large engineering firm receives an urgent call from the chief engineer of another company, asking if he knows where an engineer can be found who would be qualified to do a certain type of work and who would be willing to work for $4,000 a year, the position being permanent. The only qualified person known to the chief designing engineer is a member of his own staff whose salary is $2,500 per year, who is regularly employed but who is not under contract for any specific period. The chief designing engineer replies that he knows of no qualified person, and does not mention the opening to the engineer on his staff for important work would be seriously retarded if he lost the man in question. Has he acted fairly and ethically?*

SOCIETY AFFAIRS

Official and Semi-Official

Preliminary Plans for Los Angeles Meeting

Extensive Technical Program, July 28–30, 1943, Attuned to War Effort

PREPARATIONS FOR the scheduled meeting in Los Angeles are making good progress. Many of the features have been determined and others are still being perfected. For example, it has been decided that the meeting will be held at the Biltmore Hotel, and will extend over three days, Wednesday to Friday, July 28 to 30, inclusive. This is somewhat later in the month than normal for the summer meeting; it therefore gives more time for the necessary preparations by those near enough to attend.

It is expected that many members, together with their families and friends, especially those living in the Southwest (including all of California and Arizona) will take advantage of this opportunity.

U.S. Bureau of Reclamation

WATER IS A GREAT ENGINEERING PROBLEM
Main Canal for a Western Irrigation Project

During the two years since the previous general meeting on the West Coast, many developments in engineering have taken place. War problems and war needs are more clearly visualized, so that the exchange of experience and comparison of solutions worked out for emergency problems should be more valuable. It is expected that all who attend will receive specific encouragement and help in their war work.

As a measure of the interest being developed, it may be said that fourteen Division sessions are on the schedule, two of the Divisions having contracted for two sessions each. These sessions are scheduled for Wednesday afternoon, Thursday morning and afternoon, and Friday morning and afternoon. This sounds like rather heavy fare—and it would be under ordinary circumstances. But it must be remembered that the engineers who attend will come primarily for solid technical reasons. They will expect to devote their time almost exclusively to engineering matters of current interest.

Not that the opportunity for social assembly will be utterly lacking. On the contrary, the Wednesday evening dinner will be much as usual. Customarily this is the largest and most important gathering at which men and women join. The main difference for the Los Angeles Meeting is that it is to be informal, in keeping with the spirit of the times.

It is probable that each day, between morning and afternoon meetings, a special lunch will be provided. This is not only a matter of convenience for those attending but also a matter of enjoyment, since topics of particular interest can be arranged and well-known speakers engaged. Definite efforts toward this end are now under way. There remains the Thursday night date, for which it is hoped that special plans will be developed. Something out of the ordinary is in prospect, probably in a different setting from the rest of the meeting.

The extent of the technical interest might well be emphasized. Every one of the twelve Divisions is planning its portion of the program. Apparently it will be the first time this has happened, at least with such a full complement and variety of subjects. In earlier days, when the Divisions were few, it may be that each was represented at a single Society meeting, but certainly this has not happened in recent years. It will be apparent that the Los Angeles Meeting should be outstanding in this respect.

Recognition of war necessities has imposed some further revision on the ordinary schedule. Customarily the meetings of the Board of Direction extend over the three days preceding the technical program. A number of the Board committees usually meet on Sunday, and the Board itself convenes all day Monday and usually Tuesday. Instead of this, the Los Angeles plans call for committee meetings on Tuesday and for meetings of the Board as a whole on Wednesday afternoon and as much of Thursday as required, these meetings being coincident with the technical sessions. Thus the Board and the technical meetings are to be telescoped into the same days, under the stress of war economy.

As usual, advantage is being taken of this opportunity to call a conference of Local Section delegates from Sections within a convenient distance from Los Angeles. Invitations to participate have been extended to those western Local Sections between New Mexico, Colorado, Wyoming, and the Pacific Coast. This conference will be held all day Tuesday, the twenty-seventh. Another important feature is the Wednesday morning session required by the Constitution under the designation of "Convention." Regularly each year at this time, the President is designated to deliver his Annual Address.

By means of this July meeting, together with the Annual Meeting in January, opportunity is given every six months for such business as may logically be presented. This summer meeting is one of four usually held every year by the Society, each in a different part of the country, to give members resident in the area the opportunity to attend a Society gathering without undue traveling and expense.

One special feature is being considered for the days immediately following the Los Angeles Meeting. War conditions have made travel especially hard for Society members in the West, and Society officers have been unable to arrange their usual visits and conferences. A large number of enthusiastic members on the West Coast have keenly felt this deprivation. Therefore a number of members of the Board of Direction are planning to make a brief tour of Local Sections at the conclusion of the Los Angeles

A TYPE OF SOUTHERN CALIFORNIA ENGINEERING DEVELOPMENT
Sewage Treatment Plant at Laguna Beach

Caterpillar Tractor Co.

EXCAVATING DIVERSION CHANNEL IN SANTA CLARA RIVER
Site Is Soledad Canyon, en route to Los Angeles from Bakersfield

Meeting. The itinerary is being so arranged as to include if possible stops in San Francisco, Portland, Seattle, and Spokane on the return route to the Middle West or East.

In the next or July number the technical program will be presented in detail. The present progress report is given primarily to stimulate the interest of those near enough to take advantage of the opportunity to be present at the Los Angeles Meeting in July. A cordial welcome of course awaits all members who are able to attend, whether from near or far. However, it is recognized that attendance will be confined largely to those from surrounding areas. Judging from the plans that are being perfected, they will be well repaid.

Engineering Foundation Issues Annual Report

THE 1941–1942 Annual Report of the Engineering Foundation, recently issued, lists fifteen projects, comprising twenty-one separate problems, on which work has progressed. A summary of the year's researches in which Society Committees are cooperating is included in the Report. It outlines Project 38 of the Soil Mechanics and Foundations Division and Project 67 of the Special Committee on Hydraulic Research.

The Foundation continued its policy of contributing to a considerable number of projects in diverse fields of engineering. However, projects have been reconsidered with regard to their bearing on the war, and have been encouraged only in so far as they appear to contribute to the war effort. In several cases, grants which have been provided have not been fully utilized because of withdrawal of personnel to more direct war activities. It is expected that this trend will continue for the duration of the war, and on that account it may be impracticable to make full use of the Foundation's income on projects helpful to the national cause.

Information, Please!

WILL the member who addressed a penny postcard to the Society and mailed it in Washington, D.C., on April 27, kindly communicate with Society Headquarters? The correspondent neglected to write his request or message in the space provided for that purpose. The Society is always glad to be of service when it knows what service is desired!

CIVIL ENGINEERING Cuts Its Coat to Fit

IT IS AN old adage that counsels to "cut your coat to fit your cloth." A modern illustration is the minor change to be incorporated in the over-all size of CIVIL ENGINEERING starting with the next or July number.

It goes back to the need for conservation of paper. The government has required a 10% reduction for 1943 over that used in 1942. Many magazines, among them CIVIL ENGINEERING, are accomplishing part of this saving by a reduction in the trim size. That is, the new over-all size will be $8^1/_8$ by $11^1/_4$ in. instead of $8^3/_4$ by $11^5/_8$ in. Some uniformity is thus obtained among a number of magazines of similar character, and this, of course, is an advantage from the standpoint of like treatment of advertising and other copy for inclusion.

The reduction actually will just about meet the 10% cut in paper. Other savings that have been accomplished without undue hardship should enable the Society to exceed the limiting saving imposed and thus help further in the war effort.

In general the change will result in the reduction of margins around the page. No change in type faces, in type sizes, or in over-all type dimensions is contemplated. In other words, the typographical appearance of the publication will be maintained as before, while at the same time paper tonnage will be reduced and conserved.

Joseph R. Worcester, Hon. M. Am. Soc. C.E., Dies

LONG a leader in the engineering profession, Joseph R. Worcestor died in Waltham, Mass., on May 9, at the age of 83. Mr. Worcester was born in the same town 83 years ago, and in the neighboring city of Boston he received his training and established a notable engineering career. In the 61 years since his graduation from Harvard College he had made and preserved a fine reputation as a consultant, having been identified with many of New England's major structural problems.

JOSEPH R. WORCESTER, 1860–1943

His specialty was structural engineering. Among his many projects were elevated railroads, tunnels, and viaducts, and the Harvard Stadium. He was on the state commission that constructed the Memorial Bridge at Springfield, Mass. Early American developments in reinforced concrete also received an impetus at his hands; he represented the Society on the first Joint Committee on Concrete and Reinforced Concrete, later becoming chairman of this committee. From 1921 until recently he also served as a member of the Federal Building Code Committee, to which he was appointed by Herbert Hoover, Hon. M. Am. Soc. C.E., then Secretary of Commerce.

He was a lover of literature, of music, and of the sea. Other hobbies were astronomy and meteorology, both of which he served with a keen devotion. While Mr. Worcester was never an officer in the Society, his standing in the profession was recognized by his election—in 1937—to honorary membership. He had been president of the Harvard Engineering Society and of the Boston Society of Civil Engineers.

Of late years he had not been active in engineering work. His family's connection with the firm is carried on by his son, Thomas

Worcester, Assoc. M. Am. Soc. C.E. Another connection with engineering is through one of his three daughters, the wife of Clarence D. Howe, M. Am. Soc. C.E., Canadian Minister of Munitions and Supplies.

Appointments of Society Representatives

GIBB GILCHRIST, M. Am. Soc. C.E., has been appointed to the executive committee of the Highway Division to fill the vacancy caused by the death of COL. C. E. MYERS, M. Am. Soc. C.E. The term will expire in January 1944.

JOEL D. JUSTIN, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Engineering Foundation for the four-year term beginning in October 1943.

DAY I. OKES, Assoc. M. Am. Soc. C.E., has been the Society's alternate representative on the Highway Research Board of the Division of Engineering and Industrial Research of the National Research Council.

LANGDON PEARSE, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Board of the Washington Award.

Activities of Society Staff Regarding Employment Problems

A NUMBER of meetings and conferences were held during May aimed toward a fuller understanding of engineering employment questions. These were arranged in connection with visits of Howard F. Peckworth, M. Am. Soc. C.E., Assistant to the Secretary of the Society, assigned to problems of employment conditions. His first visit of the month was to Morgantown, W.Va., on May 7. There he spoke before an engineering group assembled at dinner near the Engineering Building on the campus of the University of West Virginia.

Immediately afterward he went to Washington, D.C., to attend a series of conferences on the same subject. Visits were made to consult Dr. E. J. Stocking, M. Am. Soc. C.E., of the U.S. Civil Service Commission; H. E. Foreman, managing director, and William Muirhead, vice-president, of the Associated General Contractors of America; and Edward Larson, Assoc. M. Am. Soc. C.E., executive secretary of the National Society of Professional Engineers.

On the return toward New York on Tuesday, May 11, Mr. Peckworth stopped in Baltimore to speak before a dinner meeting of the Maryland Section in the Baltimore Engineers' Club. It is expected that a report of this meeting will appear in a later issue.

News of Local Sections

Scheduled Meetings

DAYTON SECTION—Luncheon meeting at the Engineers' Club on June 15, at 12:15 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on June 3, at 7 p.m.

PHILADELPHIA SECTION—Dinner and meeting at the Engineers' Club on June 8, at 6 and 7:30 p.m.

PROVIDENCE SECTION—Dinner meeting at the Narragansett Hotel on June 3, at 6 p.m.

SACRAMENTO SECTION.—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on June 15 at 5:30 p.m.

SPOKANE SECTION—Dinner and inspection at the Engineers' Mess Hall, U.S. Army Air Depot, Galena, on June 11, at 5:30 p.m. (Transportation arranged by secretary.)

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the E. and W. Cafeteria on June 8, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Y.M.C.A. on June 7, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on June 14, at 12:15.

Recent Activities

ARIZONA SECTION

The annual spring meeting of the Section was held in Tucson on May 1. Speakers featured on the afternoon program were W. R. Lawrence, manager of the Tucson division of the Consolidated Aircraft Corporation, and James H. Nelson, of the Tucson Magnetic Observatory. The former's subject was "Consolidated Aircraft Modification Work and Its Relation to Wartime Needs," while Mr. Nelson presented a paper on observatory methods of obtaining magnetic and seismological data. At the luncheon, which was held jointly with the University of Arizona Student Chapter, State Senator W. F. Kimball discussed legislative aspects of the Colorado River. Following a round-table discussion of this talk, President Carollo, of the Arizona Section, announced the Section's award of Junior membership in the Society to William Pearson Adams. The presentation was made in absentia since Mr. Adams, former president of the University of Arizona Chapter, was recently called into the service.

CENTRAL ILLINOIS SECTION

On April 19 members of the Central Illinois Section heard Laurence P. Keith speak on the subject, "The Forest Fights." Mr. Keith, who is structural engineer for the Timber Engineering Company, of Chicago, Ill., first showed a sound motion picture entitled "Timber Goes to War." He then discussed the design of timber structures, emphasizing the difference between the design of such structures and that of steel structures. Mr. Keith mentioned several examples of timber structures that failed during construction because the designers were not versed in the design of such structures.

CENTRAL OHIO SECTION

Members of the Section met on the campus of Ohio State University for their April dinner meeting. Although it was not a scheduled joint meeting with the Student Chapter, a number of Chapter members were present. Speakers were Field Secretary J. E. Jagger, who discussed the activities of the Society, and Col. D. L. Neuman, who gave an illustrated talk on the building of the Alcan Highway. Colonel Neuman, who is with the Corps of Engineers, was in charge of building a portion of the highway.

CLEVELAND SECTION

"Lighting in Attack and Defense" was the subject of discussion at the April meeting of the Section. The principal speaker was Kirk Reid, illuminating engineer for the Nela Park Engineering Department of the General Electric Company. Mr. Reid brought a great deal of equipment with him to demonstrate his talk, showing the different types of lights needed on airplanes, tanks, Army trucks, and battleships. Some ten thousand lamps are needed on a battleship, he said. Mr. Reid also pointed out that dimout lamps have been perfected for home use, but these are not as yet in production. Such lamps would permit houses to be lighted and still not require the windows to be blacked out.

CONNECTICUT SECTION

Senior-class members of the University of Connecticut Student Chapter were guests of the Section on April 8. Following dinner, Henry W. Buck, Contact Member for the Chapter, presented the Section's prize of Junior membership in the Society to Harold N. Adams. The speaker of the evening was William J. Cox, Highway Commissioner of the State of Connecticut, who discussed the work

of the highway testing laboratory. Mr. Cox explained that the laboratory has developed tests to ensure the improvement of highway materials, with particular reference to tars and asphalt; acceleration tests on concrete; and methods of preventing emulsification of asphalt by rain water in the armor coating of pavements. Mr. Cox concluded his talk with a discussion of the sociological and financial aspects of highway design, pointing out the need for different formulas in apportioning funds and also the need for differentiation between maintenance obligations and new construction.

Dayton Section

The April meeting of the Section took place at the University of Dayton, with Prof. B. T. Shad and Field Secretary Jagger scheduled as speakers. Professor Shad's subject was postwar education, while Mr. Jagger discussed the role of the Society in the war effort and explained what some of the other Sections are doing.

District of Columbia

There was a large turn-out for the April meeting to hear Comdr. Donald B. MacMillan, of the Hydrographic Office of the Navy Department, speak on "Greenland and the Far North." Commander MacMillan, who was assistant to Rear Admiral Robert E. Peary on his last and successful Polar dash in 1908 and 1909, gave much timely information concerning the physical and meteorological conditions of this relatively little known area. His talk was illustrated with colored motion pictures. Arrangements had been made to have the museum of the Interior Department open for the inspection of members, and curators were available to explain the various exhibits that supplemented Commander MacMillan's talk.

Ithaca Section

Recent meetings of the Ithaca Section included joint sessions in March and April. The first of these sessions was a joint meeting with the Cornell University Student Chapter, the guest speaker being E. Leland Durkee. Mr. Durkee, who is resident erection engineer for the Bethlehem Steel Company, gave an illustrated talk on the erection of the Rainbow Bridge at Niagara Falls. In April there was a joint session—in Binghamton, N.Y.—with the Technical and Engineering Societies of Broome County. R. D. Jennison, president of the New York State Electric and Gas Corporation, acted as toastmaster at the dinner that preceded the meeting. The speaker of the evening was A. E. Marshall, president of the Rumford (Conn.) Chemical Works, who addressed the large group on "Industrial Post-War Planning."

Kansas Section

A talk on the engineering problems encountered in land appraisal comprised the technical program at the March meeting of the Section. This was given by J. B. Marcellus, engineer appraiser for the Federal Land Bank at Wichita, Kans., who explained the relation between irrigation and drainage for increased crop production.

Kansas City Section

Guests at the April 13 meeting of the Kansas City Section included members of the Federal Housing Authority. Following dinner, members and guests adjourned for a lecture by V. S. Peterson, consultant for the du Pont Company, whose subject was the role of chemistry for the duration and in the peace to follow. The lecture was sponsored by the Section and thirteen other engineering and educational organizations.

Los Angeles Section

Speakers at the April meeting of the Section were Ernesto A. Romero, Mexican vice-consul at Los Angeles, and Walter Cooper, city manager of San Diego. A new realization of the traditions and spirit of Mexico was gained from Senor Romero's talk, while Mr. Cooper discussed the astonishing changes in San Diego brought about by the war. In the last three years there has been a 75% increase in the population of the city, exclusive of military and naval personnel, he pointed out. Housing, transportation, and all other municipal utilities were found to be inadequate, though many new housing units have been put into service and more are planned. Mr. Cooper also described the new intercepting sewer and treatment plant, which are almost ready for operation.

Maryland Section

"Reinforced Concrete in the Present Effort" was the subject of discussion at the April meeting of the Section, the speaker being Arthur J. Boase, manager of the structural and technical bureau of the Portland Cement Association. Mr. Boase illustrated his talk with slides, showing some of the unusual types of construction that have been used in the past few years. Following his talk, there was an animated discussion from the floor.

Metropolitan Section

On May 12 members of the Junior Branch of the Metropolitan Section gathered for their last meeting of the season. The annual election of officers, held at this time, resulted in the selection of the following: Woodman F. Scantlebury, president; Edward E. Lustbader, first vice-president; Alexander T. Andreassen, second vice-president; Don P. Reynolds, secretary; and Sidney Weniger, treasurer. The technical program consisted of an interesting illustrated talk entitled "American Air Bases Across Africa." This was given by Willis C. Lowe, construction representative for Pan-American Airways, who pointed out the engineering problems connected with the "construction of a string of airfields extending to Asia."

Mid-South Section

The spring meeting of the Mid-South Section—held in Little Rock, Ark., on March 26—attracted an attendance of 70. Early in the morning the meeting got under way with an address of welcome by V. E. Scott, assistant director and secretary to the Arkansas State Highway Commission. In the first address of the morning an extensive public works program, to be financed by municipal funds, was forecast by Marion L. Crist, of the Little Rock firm of Marion L. Crist and Associates. Mr. Crist emphasized the need for planning now to take care of postwar needs. Thorold F. Field, head consultant on bauxite production for the War Production Board at Little Rock, then spoke on "The War Production Board and Bauxite Production." Both talks were discussed. Speakers at the afternoon session were John Strom, senior highway engineer for the Arkansas State Highway Commission, who discussed bridge expansion devices, and J. R. Thoenen, district engineer for the U.S. Department of the Interior. The program also included the showing of two films—one on the Alcan Highway, and the other entitled "Commando Training Under Fire." A dinner with the Arkansas Engineers' Club concluded the meeting.

New Mexico Section

On April 14 members of the New Mexico Section were guests of the University of New Mexico Student Chapter at Albuquerque. Following a discussion of business matters, C. E. Smith presented a paper entitled "New Wrinkles in Wrinkled Tin." Mr. Smith is a representative of the Hardesty Division of Armco Drainage and Metal Products, Inc. The group then adjourned to a restaurant for refreshments.

North Carolina Section

Speakers at the spring meeting of the North Carolina Section—held in Raleigh on April 14—were Charles M. Spofford, Vice-President of the Society and Boston consultant; T. F. Hickerson, professor of applied mathematics at the University of North Carolina; and George T. Seabury, Secretary of the Society. Professor Spofford discussed the function of the Local Section, pointing out that the Section can perform a great service to the Society by having active membership committees to aid the Society in judging the merits of applicants for admission, and active publicity committees to keep before the public the true function of the civil engineer. Professor Hickerson then presented a paper on the "Calculation of the Astronomical P.Z.S. Triangle." In the concluding address of the evening Mr. Seabury spoke on the work the Society is doing in the present emergency and discussed the engineering outlook for the future. A dinner preceded the meeting.

Northeastern Section

The April meeting of the Section took the form of a joint session with the Boston Society of Civil Engineers. Maj. E. J. Brehaut, assistant chief of the Office of Army Procurement, 1st Service Command, explained the needs of the Army for construction en-

gineers and engineering specialists to operate as members of the military in the government of occupied areas. The speaker of the evening was Col. C. A. Gow, who reminisced most interestingly on his fifty years of engineering experience.

Northwestern Section

A talk on "Manpower, a Problem of Distribution," comprised the technical program at the April meeting of the Northwestern Section. This was given by Hubert H. Humphrey, assistant director of the Twin Cities War Manpower Commission, and a discussion from the floor followed his address. During the evening it was announced that George M. Shepard, president of the Section, will be away from the Twin Cities for some time, while serving as chief engineer for the Okes Construction Company on work on the Alcan Highway. During his absence First Vice-President Paul R. Speer will be acting president.

Philadelphia Section

On April 13 Lester M. Goldsmith, chief engineer of the Atlantic Refining Company at Philadelphia, described in detail the operation of raising the sunken oil tanker, "E. H. Blum," which was broken in two by a series of explosions off the coast of Virginia on February 16, 1942. Colored motion pictures showing the vessel from the time of its launching, through the period of disaster and salvaging, to the completion of repairs, enabled the audience to see the conditions to be met and to follow each step of the salvaging process. An enthusiastic discussion from the floor concluded the program.

Pittsburgh Section

Following a dinner meeting on May 6, members of the Pittsburgh Section adjourned for a joint session with the civil section of the Engineers' Society of Western Pennsylvania. The gathering was addressed by G. G. Greulich, sales representative for the specialty sales division of the Carnegie-Illinois Steel Corporation, on the subject, "Steel Landing Mats for Aeroplane Runways." Later Mr. Greulich showed films on the making and shaping of steel.

Providence Section

There was an attendance of over 400 for the April meeting to hear Brig. Gen. C. L. Sturdevant, Assistant Chief of Engineers, U.S. Army, speak on the Alcan Highway. Before the meeting—a joint session with the Providence Engineering Society—there was a dinner in honor of General Sturdevant. Guests at the dinner included a number of high-ranking officers from the various Army and Navy units in the area as well as officers of both engineering groups.

Puerto Rico Section

The Puerto Rico Section reports a good meeting in March, with a good attendance. On this occasion the speaker was Capt. H. K. Eggleston, who covered the subject of concrete aggregates and field control of concrete in Puerto Rico. Captain Eggleston compared the types of aggregates to be found locally with those found in the northeastern part of the United States, commenting that they are generally inferior in structural strength and very poorly graded.

Sacramento Section

At its first three April meetings, the Sacramento Section heard discussions on "Post-War Planning for Sacramento" and "Highway Engineering from the Motorists' Standpoint," and saw the Bethlehem Steel Company's film entitled "Steel for Armored Forces." On April 27 O. J. Porter, physical testing engineer for the California State Division of Highways, presented an illustrated lecture on "Developments in the Design of Runway Pavements." Mr. Porter traced the "California Method" of soil-bearing evaluation from scattered field tests, through comprehensive track tests at Brighton, to acceptance by the Corps of Engineers for incorporation in the Engineers' Manual. Recent experiment included observation by oscillograph of 40-ton wheel loads moving over airport pavement at Stockton. This method is applicable to soils supporting flexible pavements and adaptable to highspeed construction in the theater of operations.

San Francisco Section

On April 20 two Student Chapter members—John T. Graff, of the University of California, and Franklin A. Brown, of the University of Santa Clara—were dinner guests of the Section and were introduced to the membership as the recipients of the Section's annual prizes of Junior membership in the Society. The technical program consisted of an address by Dr. Laurence I. Hewes on the Alcan Highway. Dr. Hewes, who is chief of the Western region of the Public Roads Administration, illustrated his talk with colored slides.

At a meeting of the Junior Forum, held on March 25, a talk on concrete ships, by Fred Taylor, comprised the technical program. Mr. Taylor is an engineer with Ellison and King, structural engineers of San Francisco. A spirited round-table discussion on the postwar policy of the United States concluded the meeting.

Spokane Section

Problems of water supply and sewage treatment were discussed at the April meeting of the Spokane Section. The principal speaker was Emil C. Jensen, district sanitary engineer for the Washington State Department of Health, who introduced his topic by showing a motion picture on the "Cycle of Water and Health." He then commented on the water-purification and stream pollution problems of the major streams in eastern Washington. At the conclusion of his remarks W. L. Malony discussed the design of the large sewage-treatment plant serving the Farragut Naval Training Station.

Tennessee Valley Section

On April 9 members of the Chattanooga Sub-Section met with local groups of the American Society of Chemical Engineers, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers, the program being arranged by the latter organization. A talk on "The Combustion of Coal as Applied to Power Generation"—presented by A. R. Mumford, development engineer for the Combustion Engineering Company—comprised the technical program.

The Knoxville Sub-Section met on April 13 to hear E. W. Harsch give an illustrated lecture on the subject, "Raising Walters and Swann Highway Bridges in Douglas Dam Reservoir." Mr. Harsch is principal highway engineer for the TVA.

Toledo Section

The principal speaker at the April dinner meeting of the Section was George W. White, professor of geology at Ohio State University, who presented an illustrated talk on the geological formations and the effects of erosion on the different types of clay and rock along the shore of Lake Erie. During the evening George N. Schoonmaker gave a résumé of the Annual Meeting of the Society. The guests of honor included Frank L. Raschig, director of the Ohio State Department of Public Works.

Wyoming Section

The Section's prizes of Junior membership in the Society were announced at the April 10 meeting. The recipients were Roy Sutton and Jerry McDermitt, both members of the University of Wyoming Student Chapter. Ernest E. Howard, Director of the Society from Kansas City, was present and spoke on the history of the Society and the future of engineering. At the conclusion of the meeting Dean R. D. Goodrich paid brief tribute to R. Lee Donley, who is joining the Navy.

Student Chapter Notes

College of the City of New York

The Student Chapter at the College of the City of New York reports a number of interesting activities. Recent speakers include Cornelius Wandmacher, who addressed the group on April 29. Mr. Wandmacher, who is assistant professor of civil engineering at Brooklyn Polytechnic Institute, spoke on the Watkins Glen Bridge, using this structure to exemplify the problems arising in the erection process. In concluding, Mr. Wandmacher emphasized the necessity of a broad approach to engineering problems.

ITEMS OF INTEREST

About Engineers and Engineering

General Fleming Urges Plans for Postwar Work

THE URGENT need for specific project plans of work to be done after the war was expressed by Maj. Gen. Philip B. Fleming in a recent address at St. Paul, Minn. In his message, which was of particular interest to civil engineers, the Administrator of the Federal Works Agency said, in part:

"From my reading of history I do not recall that ever before were so many people trying to plan the future as at the present time.

"There are literally hundreds of state, municipal, and regional planning boards and commissions busy at their drawing boards in an effort to blueprint the postwar America. In addition there are scores of private planning organizations whose proposals arrive at my desk in Washington almost daily. Nor is private business wholly marking time until the war ends. Trade associations are cooking up plans of their own, and at least the larger corporations are equally intent upon efforts to read, or shape, the future.

"Where so many cooks have their fingers in the postwar planning pie, it would be surprising to find them in unanimous agreement. There are very decided differences of opinion as to methods; there is even disagreement as to objectives.

"But as to one aspect of the postwar future there is almost no room for controversy. I refer to what is generally called public works. Public works do not conflict with anyone's deep-seated philosophy about life. They do not involve economic or political ideologies at all.

"During the war we are accumulating an enormous backlog of unmet need, and it will continue to grow until the day of victory. Even if we should then seek to do no more than catch up on normal maintenance, many years of building would be necessary in the counties, towns, and cities of the nation. Much more must be done if we expect to provide as much in community facilities and convenience as we knew before the war.

"In any plans that may be made, public works construction must of necessity play an important part for these reasons: Construction employs more people, directly and indirectly, than any other activity in which government can engage; it does not compete with private business; public works are needed on their own account.

"I think we will have to decide upon a nation-wide plan so that we can have a national reservoir of public works that can be turned on when and where the employment need is great, and turned off where and when the need is not so great. For example, if private business in St. Paul is able to provide all the jobs needed in St. Paul at a given time, it would be folly for the municipality to choose that exact time for inaugurating a vast program of public works that would bring it into competition with private business for men and materials. . . . Unless our plans are national in scope, there will be no administrative way by which we can cut the cloth to fit the need.

"No matter how much money may be available for public works at the end of the war, there will be no jobs on them for many months, unless the preliminary engineering steps have been taken before the end of the war. That's why, in speaking about the place of public works in the postwar readjustment, I prefer to talk about advance engineering surveys instead of postwar planning. For in making advance engineering surveys and in acquiring needed sites, there is nothing theoretical or ideological: it is a simple matter of 'getting set' in time.

"Recently I had a letter from a man in Chicago, a man who is in a position to know, who tells me that before the middle of the summer of 1943 some 18,000 civil engineers and architects will be displaced from construction activities. A few of these may go into the armed services. But probably most of them are too old for military service, or could not meet the physical requirements. Some may be able to find jobs in war plants. A great many probably could be put to work at once preparing for postwar construction, to the benefit of the entire nation.

"A few days ago a delegation from the American Association of State Highway Officials came to see me. They already had presented a proposal to Congress for a three-year postwar highway program to cost a billion dollars a year. They assured me that a billion dollars would provide 750,000 men with jobs for a year in highway construction.

"The city of New York right this moment is proceeding with the advance engineering of a half-billion-dollar public-works program to be inaugurated when the last shot is fired. Among other things, sites are being acquired for great new housing developments. But taking the country as a whole, very little has been done to translate paper proposals into steel, stone, concrete—and jobs. This is the next step that must be taken. Whether it is to be directed by the federal government, or by states and municipalities, is less important than that it should be done, and done now.

"There are some, of course, who tell us that this is not the time to bother about the future; that the only thing we should think about now is the winning of the war, after which the future will take care of itself. That was the mistake we made the last time. Unfortunately, the war and the peace that is to follow it are not separable. And unless we concern ourselves now with the sort of world we want to live in hereafter, our war-time sacrifices may prove to have been in vain."

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"THE STRAIGHTFORWARD problem assigned for this meeting of the Engineers Club is just an introduction for a more cerebrum-consuming sequel, related to the idealistic idea that the world will do what Al, Ben, Cal, Don, Ed, and Fred did. So watch out for clues while I ask someone to solve the introduction."

"I did it in a straightforward analysis," said Cal Klater. Letting a, b, c, d, e, and f be the respective initial holdings and x the common final holding, I operated algebraically on each holding thru the successive divisions and distributions until I had six equations in seven unknowns, of which this was the first:

$$(0.561051a + 0.14641b + 0.1331c + 0.121d + 0.11e + 0.1f = x \qquad (1)$$

If x were known, the solution would follow, so we can solve for the others in terms of x, getting:

$$\begin{aligned} a &= 0.65536x & d &= 1.030144x \\ b &= 0.753664x & e &= 1.222144x \qquad (2) \\ c &= 0.876544x & f &= 1.462144x \end{aligned}$$

Since one of the unknowns is $\$4{,}024.00 > x$, I substituted this amount in turn for d, e, and f. When $d = 4{,}024$, $x = \$3{,}906.25$, and this is the answer, for the other substitutions split cents badly."

"Cal must be right," said Titus Wadhouse, "but I prefer my backwards synthesis to his straightforward analysis. Start at the conclusion that each man has x dollars. Reverse the final operation by letting each of the others give Fred $0.2x$ to double his holding. After six reversed distributions, Eqs. 2 are reached more easily than by Cal's method."

"I'll say you are both right," replied the Professor. "There are a dozen ways of getting the right answer and each way must be right if it was the easiest way for somebody."

"I have a general solution independent of the number of . . . ." "Let's save it for the sequel," interrupted the professor. "Let's enlarge our six tentative communists to include everybody on earth—say, two billion souls, of whom the poorest is Aaron Aab and the richest, Zygmund Zyzyx. Beginning with Aab, each in turn divides half his holding equally among the other 1,999,999,999 so that each holds the same amount at the end. How much richer was Zyzyx than Aab?"

"Impossible," ejaculated Tom Dowtz. "There isn't enuf money in the world to do it. Even if the $30,000,000,000 worth (more or less) of gold and silver in the world were inflated to 200 billions in currency, that's only $100 apiece, but it takes $156.25 apiece to swing the deal for just 6 men."

"Granted as to our total resources, but we can create a smaller piece of change

than the cent. Suppose the postwar yen proved adaptable, Tom, I'll assign you the extra problem of computing its value."

[*Cals and Tituses were, chronologically, F. G. Switzer, Richard Jenney, Kum Pewter (Walter Steinbruch), a Nuther Nutt (still incognito), F. T. Llewellyn, Count Harvey, Isidore Knobbe (Joseph S. Lambie), Charles A. Ellis, X. Tracter (Benjamin Eisner), Arthur L. Elliott, John, E. Burke, James R. Bole, and O'Kay (Otto H. S. Koch)—each with a different method. Richard Jenney has the general solution and suggested the sequel.*]

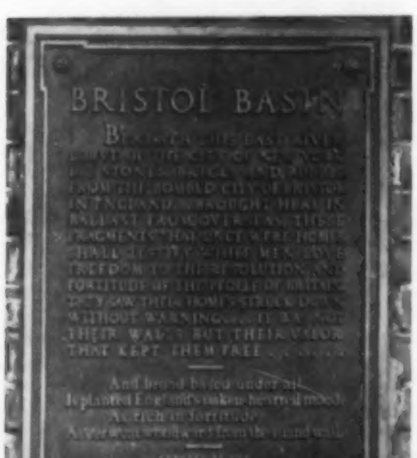
General Somervell Addresses Chamber of Commerce

THE keynote address of the Chamber of Commerce Convention, held in New York on April 27, was given by Lt. Gen. Brehon B. Somervell, Hon. M. Am. Soc. C.E. In his frank appraisal of the situation faced by industry at war, General Somervell stressed the necessity of an ever-increasing production output. The rumor that work on certain war materials has been ordered suspended was spiked by a concise description of the constant change to better equipment that is necessary to keep ahead of our enemies.

General Somervell said that such rumors, whether enemy inspired or not, must not be allowed to slow the flow of materials to the fighting fronts. His remarks drew much applause from the thousands in attendance at the opening session of the convention.

Bristol Basin Celebration

LEARNING that rubble, brought to this country in ballast from the bombed city of Bristol, England, was being used as fill in the construction of the new East River Drive in Manhattan, the English Speaking Union of the United States offered to commemorate the fact with a suitable memorial. The City of New York accepted the offer, and on June 28, 1942, Dr. James Rowland Angell, president of the Union and president emeritus of Yale University, presented a bronze plaque. The presentation was made in the presence of British and American officials, troops, and a contingent of sailors from the British Navy. Also attending the ceremonies were Godfrey Haggard, British Consul-General in New York, representing Lord Halifax; Mayor LaGuardia; Edgar J. Nathan, Jr., president of the Borough of Manhattan; Walter D. Binger, M. Am. Soc. C.E., Commissioner of Borough Works; and other officials.



BRISTOL BASIN COMMEMORATIVE TABLET

The East River Drive—a $7^1/_2$-mile express highway, restricted to passenger cars—and the commercial marginal way by which it is intermittently flanked, run the length of the east shore of Manhattan and have recently been completed at a cost of about forty-six million dollars. The drive is partly on fill placed behind a relieving platform on piles. However, where insufficient room was found between the legal bulkhead line and the existing building line, the drive was placed on a double-deck and, in places, on a triple-deck concrete viaduct in deep water.

The major portion of the inscription on the tablet placed by the English Speaking Union was written for the occasion by the late Stephen Vincent Benet, American poet and author, while the quotation therein is from Bayard Taylor, an American writer of the last century.

Bristol Basin along the East River replaces an old and ramshackle system of docks used for the same purpose before the East River Drive was built. While the war has temporarily ended the use of small boats and yachts except for war purposes, it is believed that the Basin will be very popular later. The pier is a favorite spot for strollers, who see the sign "Bristol Basin Parking" as they descend the stairway from the bridge and pass the commemorative tablet on their return.

Postwar Plans by New York State Commission

At a recent meeting of the Conference Committee on Urban Problems of the U.S. Chamber of Commerce, in Washington, D.C., functions of the New York State Postwar Public Works Planning Commission were discussed in the paper prepared by Holden A. Evans, Jr., Executive Secretary of the Commission. Aiming to coordinate the public works plans prepared by the State and municipalities within the State, the Commission has recommended that designs be completed for projects totaling $290,000,000, the work to be started immediately after the war has been won. Excerpts from his paper appear below.

AFTER THE SHOCK of Pearl Harbor had subsided, the thoughts of many New York State officials turned to the war and its effect on the people of the State. In view of all the uncertainties, it was their opinion that a program of public works improvements should be instituted so that the State would be able—if necessary—to aid in bridging successfully the transition from war production to peace production with the least possible dislocation in our economy and the greatest possible employment. Although there were several agencies throughout the State engaged in various phases of postwar planning, it was the unanimous opinion of all concerned that the problem of public works construction should be handled by a separate commission, made up of the men most familiar with this particular phase of the work.

The law establishing the Commission gave it five main duties:

1. To keep a record of the progress of designs now being prepared by State agencies.
2. To prepare and maintain progress information on the design of postwar projects by municipalities in the State.
3. To keep a record of employment possibilities and material and equipment needs involved in these projects.
4. To allot funds for the design of additional State construction.
5. To maintain liaison with federal officials and agencies concerned with postwar planning.

This act appropriated $450,000, of which $50,000 was for administration. In the light of these duties, it was our first job to canvass all the State agencies and compile a detailed record of the designs being prepared. This was not particularly difficult as most of the projects clear through the State Department of Public Works.

The duty of canvassing the municipalities, as regards the progress of design of projects which they themselves were preparing, was another matter. Many of the municipalities were somewhat suspicious of the State and consequently were reluctant to file this data. However, little by little, we have been able to gather this information, and we now have what I believe is almost a complete record of the designs being prepared by the various municipalities in our State.

The Commission has just embarked upon the compilation of data concerning employment possibilities and material and equipment needs for the execution of these projects. It is our intention, when this work is done, to have these records in such form that the industries involved will be able to tell very quickly what is in store for them when the contracts for these various improvements are let. In other words, these data will be broken down in such a manner that the steel industry can come to us and very quickly find out the tonnage that will be required in the event that such and such a project is instituted. We will likewise be able to tell the various labor unions how many of their men will be employed on these projects. These records will, of course, be available to the public, government officials, and industry alike.

Of the $450,000 appropriation, $400,000 was for the preparation of plans for state building construction. Thirty-two projects were approved and the designs financed from this appropriation. About half of these were to be done by the State Architect, while the rest were assigned to private architects.

The final duty listed in the law was to "maintain liaison with federal officials and agencies concerned with postwar planning." Many who have followed postwar planning as it is being carried on in Washington, D.C., are well aware that, if this duty was carried out to the letter of the law, it would require a stupendous staff and a tremendous appropriation. In fact, we would undoubtedly have to open a branch office in Washington that would be much larger than our main office in Albany.

Some time ago I wrote the National Resources Planning Board and asked for a list of federal agencies engaged in postwar planning generally, and also a list of those federal agencies engaged in public works planning specifically. The list is about a foot long and growing daily. As a result we have been able to contact only the principal federal agencies so engaged.

Briefly, that is the way we are complying with the specific duties contained in the law. There is much more, however, to our work.

Our procedure with respect to projects submitted runs something like this: The application is submitted by the locality. The project is investigated by the field force of our Department of Public Works. On the basis of this investigation, a recommendation is made to the Commission, and the Commission passes on these projects and allocates the State's share of the cost of the plans. Tentatively, we are setting as a goal a program of municipal projects totaling $290,000,000. Approximately $75,000,000 of these will come from New York City.

The Commission in its first report to Governor Dewey and the Legislature has recommended that funds be provided to commence the design of four mixed-traffic superhighways, known as "thruways." The first and largest is to start at the New Jersey–New York State line and proceed north to Albany, thence west to Buffalo and down along Lake Erie to the Pennsylvania border. The Federal Government made $480,000 of matched money available in the summer of 1942 to commence the design of this thruway.

A second thruway, to be known as the Niagara Thruway, is to run north through Buffalo, under or over the Buffalo River, and then over the Grand Island Bridges to Niagara Falls, where it will connect with the Rainbow Bridge and the Queen Elizabeth Highway to Toronto.

A third thruway, from a point on the main thruway near Albany and running east to the Massachusetts line, would be known as the Berkshire Thruway, and would provide a direct east-west route from the Massachusetts line to the Pennsylvania line near Buffalo.

Finally, a route from Pelham to Portchester, to relieve the very bad congestion between these points on the Boston Post Road, would be known as the New England Thruway.

In addition to the funds for these thruways, funds for the design of the extension of the State Parkway system have been requested. It is proposed first to begin the preparation of the designs of a new parkway to be known as the Palisades Parkway, which eventually will extend from the Bear Mountain Park to the George Washington Bridge. In addition to this, the Commission proposes to have designs prepared for the extension of the existing Taconic, Northern, and Southern State parkways.

The Commission has also requested that an appropriation be made so that additional funds can be allocated to private architects for the design of $35,000,000 worth of State structures. Finally, the Commission has recommended that funds be provided so that the municipal program can be started. Taken all together, it can be readily seen that NewYork State will be in a good position to undertake a program of public works whenand if the need arises.

NEWS OF ENGINEERS

Personal Items About Society Members

Theodore B. Parker will sever his connection as chief engineer for the Tennessee Valley Authority on June 15 in order to become head of the department of civil and sanitary engineering at the Massachusetts Institute of Technology. For the time being he will continue to serve the TVA in a consulting capacity on major engineering problems. Mr. Parker will be succeeded as chief engineer by Clarence E. Blee, project manager at Fontana Dam. Other recent changes in the TVA staff include the promotion of Robert A. Monroe from the position of assistant to the chief engineer to that of assistant chief engineer.

John R. Clifton, major, Coast Artillery Corps, U.S. Army, has been assigned to duties as a plans and training officer for the Corps at Camp Stewart, Ga.

F. E. Caspar, for the past seventeen years senior civil engineer for the city of Orange, N.J., has been named city engineer to replace the late Kenneth F. Crane.

John P. Titus, first lieutenant, Air Corps, U.S. Air Corps, U.S. Army, is now an engineering officer in a bombardier training squadron, with headquarters at Midland, Tex.

Gerard A. Rohlich, formerly assistant professor of sanitary engineering at Pennsylvania State College, has accepted the position of senior civil engineer (sanitary) in the Water and Sewer Unit, Repairs and Utilities Branch Office of the Chief of Engineers, Washington, D.C.

John A. C. Callan is now in the U.S. Office of Education, Washington, D.C., acting as field representative on the ESMWT program. Until lately Mr. Callan was airport paving engineer for the Civil Aeronautics Authority, Region II, at Atlanta, Ga.

Franklin W. Fish, Jr., was recently promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. His present assignment is that of post engineer at Kearns Field, Utah.

George M. Stiers, in charge of construction for the Amis Construction Company, Oklahoma City, Okla., has been commissioned a lieutenant (jg) in the U.S. Naval Reserve and assigned to the Construction Battalions. He is stationed at Williamsburg, Va.

Carl E. Kindsvater recently resigned as assistant hydraulic engineer in the Flood Control Section of the Tennessee Valley Authority at Knoxville, Tenn., in order to accept a position in the Hydroelectric Planning Department of the U.S. Engineer Office at Little Rock, Ark.

Kenneth E. Ristau has been promoted from the rank of captain in the Corps of Engineers, U.S. Army, to that of major. At present Major Ristau is stationed in Alaska.

Thomas P. Pendleton was recently appointed by the Secretary of the Interior to the position of chief topographic engineer of the U.S. Geological Survey, with headquarters in Washington, D.C. Since September 1941 Mr. Pendleton has been chief of the Photo-Mapping Section of the Survey.

George E. Tomlinson is now a lieutenant colonel in the U.S. Marine Corps, stationed in Washington, D.C., the rank representing a promotion from that of major.

Ernest P. Goodrich, New York City consultant, has been named a member of the Price Adjustment Board of the U.S. Navy, with headquarters in Washington, D.C.

George W. Howson has established his headquarters in Sacramento, Calif., where he is the new field coordinator of the Central Valley Project studies.

John B. Huebner, recently promoted from the rank of first lieutenant in the Army Air Corps to that of captain, is at present located with the Antilles Air Task Force at San Juan, Puerto Rico. He was formerly stationed at Little Rock, Ark.

R. P. Pennoyer now has the rank of colonel in the Infantry of the U.S. Army and is stationed at Charlottesville, Va. He was previously in charge of the sales engineering department of the Carnegie-Illinois Steel Company.

George E. Symons has resigned as chief chemist for the Buffalo (N.Y.) Sewer Authority in order to become associate editor of *Water Works and Sewerage*. He will be located in New York. For several years past Dr. Symons has been secretary of the Buffalo Section.

Robert W. Thompson was recently advanced from the rank of first lieutenant in the Corps of Engineers, U.S. Army, to that of captain. He is assistant port engineer at Newport News, Va.

Richard C. Hagy, formerly an engineer for I. S. Towsley, of Philadelphia, Pa., now has the rank of ensign in the Civil Engineering Corps of the U.S. Navy. He is stationed at Williamsburg, Pa.

A. L. Kuykendall has been promoted from the rank of lieutenant in the Civil

Engineering Corps of the U.S. Navy to that of lieutenant commander.

A. M. BRENNEKE has severed his connection with the District Engineer's Office at Denison, Tex., in order to become a construction engineer for Pan-American Airlines in overseas service.

RALPH J. MCMAHON recently resigned as chief engineer in the State (Texas) Land Office in order to accept the position of chief cartographer with the Magnolia Petroleum Company at Dallas, Tex.

CLAUDE J. ROGERS, assistant county engineer of Jefferson County, Alabama, is to have the additional duties of supervision of highways and the bridge maintenance and sanitary departments.

MARVIN O. KRUSE, previously designing engineer for the Stanley Engineering Company at Muscatine, Iowa, has entered the Corps of Engineers, U.S. Army, having the rank of captain.

CLARK H. ELDRIDGE is a civilian internee in Kobe, Japan. As general superintendent of construction work on Guam Island for Pacific Naval Air Base Contractors, he was captured. First news of Mr. Eldridge came by short-wave radio and later was confirmed through the International Red Cross.

L. L. HUGHES was recently promoted from the rank of lieutenant (jg) in the Civil Engineering Corps of the U.S. Naval Reserve to that of lieutenant. At present he is stationed in New York.

MAX W. KING, for the past six years superintendent of construction for the Mexican National Irrigation Commission on the Azucar Dam, has been transferred to Mexico City as consulting engineer on their construction work throughout Mexico.

E. A. KEMMLER, who retired in 1941 after thirty-eight years in public service work in Akron, has been drafted as special engineer to help out during the city's war-induced shortage of engineers.

JAMES H. LE VAN has been promoted from the position of passed assistant sanitary engineer in the U.S. Public Health Service to that of sanitary engineer. His headquarters are still in Atlanta, Ga.

THOMAS J. MORRISON, formerly regional director of the WPA at Rochester, N.Y., has taken up new duties with the Manpower Control Commission in New York.

SHERMAN M. WOODWARD has retired as chief water control planning engineer for the Tennessee Valley Authority after ten years with the organization, but will serve in an advisory capacity to the chief engineer. Mr. Woodward, who was recently elected an Honorary Member of the Society, will be succeeded by JAMES S. BOWMAN, former assistant chief water control planning engineer.

C. R. YOUNG, dean of the faculty of applied science and engineering at the University of Toronto, has been awarded the honorary degree of doctor of engineering by Stevens Institute of Technology. The citation accompanying the presentation, which was made on May 1, reads in part, "As a visitor from a country allied with us again in this present World War, he is symbolic of that international friendship and cooperation so essential in the building of a better, more peaceful world."

DECEASED

CHARLES HENRY BARTH, JR., (M. '41) brigadier general, Corps of Engineers, U.S. Army was killed in an airplane crash in Iceland on May 3, 1943. He was 39. General Barth had been in the Army since his graduation from West Point in 1925. He had been company officer and company commander with the 13th Engineers at Fort Belvoir, Va.; training officer with the 3d Engineers at Schofield Barracks, Hawaii; and instructor at the U.S. Military Academy. From 1936 to 1939 he was with the Rock Island (Ill.) Engineer District, and from 1940 until recently he was in the special engineering division of the Panama Canal. General Barth received his promotion from the rank of colonel only a few weeks before his death.

ALFRED CARROLL BELL (Assoc. M. '01) of Milwaukee, Wis., died at his home in that city on April 5, 1943. Mr. Bell, who was 72, had spent much of his career with the Wisconsin Bridge and Iron Company, and at the time of his retirement in 1934 was vice-president and sales manager. He had also been with the Milwaukee Bridge and Iron Company and the Lafayette (Ind.) Bridge Company. During the first World War Mr. Bell headed the Milwaukee organization of structural steel manufacturers promoting steel fabrication for shipbuilding.

BERNARD BENFIELD (M. '03) consulting engineer of San Francisco, Calif., died on March 4, 1943. Long a resident of San Francisco, Mr. Benfield had for many years maintained a consulting practice there.

EDWARD CARTWRIGHT CONSTANCE (M. '22) engineer in the U.S. Engineer Office at St. Louis, Mo., died on April 29, 1943. Mr. Constance, who was 68, had spent his entire career in the U.S. Engineer Office, having begun work there as a surveyman in 1904. During part of this period he was in Kansas City, Mo., in charge of construction work on the upper Missouri. His construction projects included many feet of permeable pile dikes and revetment.

JERRY DONOHUE (M. '29) president of the Jerry Donohue Engineering Company, Sheboygan, Wis., died on April 13, 1943, at the age of 57. From 1910 to 1921 Mr. Donohue maintained a consulting practice in Sheboygan, and from the latter year on he was president of the Jerry Donohue Engineering Company. He also served for several years (1929 to 1931) as chairman of the Wisconsin State Highway Commission.

DE CLERMONT DUNLAP (M. '88) civil engineer of Los Angeles, Calif., died on April 12, 1943, at the age of 91. Mr. Dunlap had been with the Chicago and Northwestern Railway, the Chicago, Milwaukee and St. Paul, and the Union Pacific, having charge of the revision of the latter railroad's line over the summit of the Rocky Mountains. While assistant chief engineer of the Sanitary District of Chicago, he was in charge of the construction of the Chicago Drainage Canal. Mr. Dunlap's inventions included a continuous rail joint, and a combined manhole and catch basin (self-cleaning) for city sewer systems. He also designed plans for operating a monorail system of rapid transit.

JAMES HAWORTH EATON (M. '20) for the past two years associate structural engineer for the National Bureau of Standards, Washington, D.C., died suddenly on April 1, 1943. He was 62. For a number of years (1912 to 1918 and 1931 to 1941) Mr. Eaton was associate structural engineer in the Office of the Supervising Architect of the Treasury Department in Washington. He had also been with the New England Power Company and, during the first World War, designed and constructed concrete ships for the Emergency Fleet Corporation of the U.S. Shipping Board.

ROBERT WILSON FENN (M. '08) retired civil engineer of Lindsay, Calif., died there on March 20, 1943, at the age of 75. Mr. Fenn went to California in 1903 as a geologist for the Union Oil Company, with which he was intermittently connected for almost thirty years. He spent four years in charge of the construction of an oil pipe line across the Isthmus of Panama for the company. His work also took him to Chile, Peru, and Brazil. For a time he was in the employ of the Brazil Geodetic and Geological Survey, and for two years was a professor in the engineering department of the American College at Sao Paulo, Brazil.

JOHN LINCOLN HALL (M. '07) structural engineer of Seattle, Wash., died in that city on April 9, 1943. He was 82. From 1896 to 1916 Mr. Hall was with Purdy and Henderson, having served the organization as manager in Chicago and New York and vice-president in Seattle. From the latter year on he was in private practice in Seattle. Mr. Hall was in charge of the design of the Hippodrome in New York and the Metropolitan Tower, which at the time of its construction was the tallest building in the world.

ROBERT LESLIE HOLMES (M. '21) engineer of water supply for the Texas and Pacific Railway Company, Dallas, Tex., died at Sanatorium, Tex., on April 26, 1943. Mr. Holmes, who was 62, had spent his entire career with the Texas and Pacific, having started as chairman and rodman in 1900. Since 1916 he had been engineer of water supply, engaged in river improvement work and the design of a water system and treatment plants for the railroad.

SHERMAN AUGUSTUS JUBB (M. '13) construction engineer of Los Angeles, Calif., died on December 16, 1942. Mr. Jubb, who was 73, had for a number of years

maintained a consulting practice in Los Angeles. Before that he was assistant harbor engineer in direct charge of Los Angeles Harbor improvements, and from 1907 to 1912 he maintained a consulting practice in San Francisco. At the outset of his career he had been with the Boston Board of Survey and the Boston Transit Commission.

JAMES WALTER RICKEY (M '05) former chief hydraulic engineer for the Aluminum Company of America, died at his home in Washington, D.C., on April 19, 1943. He was 71. Early in his career—1897 to 1907—Mr. Rickey was principal assistant engineer for the St. Anthony Falls Water Power Company and the Minneapolis Mill Company. He then became chief hydraulic engineer for the Aluminum Company of America, and for the next thirty years was in charge of the design and construction of all the company's dams and many important hydroelectric developments. These projects include the Cheoah Dam and power house in North Carolina and the Chute-a-Caron development north of Quebec. Following his retirement in 1938, Mr. Rickey acted as consultant for the Aluminum Company.

GEORGE LOOMIS ROBINSON (M. '10) consulting engineer of New York, N.Y., died at his home in that city on April 21, 1943. For many years president of the New York Sewage Disposal Company, Mr. Robinson had maintained a consulting practice in New York since 1929. During the first World War he served with the Seventh Regiment.

HARRY ROBINSON SAFFORD (M. '08) executive vice-president of the Missouri Pacific Lines, Houston, Tex., died suddenly at Hot Springs, Ark., on April 10, 1943. Mr. Safford, who was 68, had spent his entire career in railroad work. He was with the Illinois Central Railroad from 1895 to 1911, and chief engineer for the Grand Trunk Railway from 1911 to 1918. From the latter year to 1920 he was assistant regional director of the U.S. Railroad Administration. He then became connected with the Chicago, Burlington and Quincy Railway, serving as vice-president from 1921 to 1925. Just three days before his death Mr. Safford received in person the Society's certificate of life membership at ceremonies in connection with the Texas Section's semiannual meeting in Dallas.

HYMAN HENRY SHER (Jun. '38) architectural engineer for Albert Kahn, Inc., of Detroit, Mich., died on February 18, 1943. Mr. Sher, who was 29, graduated from the University of Illinois in 1938. In the following year he was designer draftsman for Leo J. Weissenborn, and from 1941 on with Albert Kahn, Inc.

LINFORD SPEARING STILES (M. '23) construction engineer for the Brooklyn (N.Y. Union Gas Company, died suddenly on May 5, 1943. For seven years Mr. Stiles was with I. P. Morris, of Philadelphia) and for four years was draftsman and designer for the United Gas Improvement Company. From 1902 he was with the Brooklyn Union Gas Company—until 1906 as assistant to the chief engineer and after that, as construction engineer.

JOSEPH RUGGLES WORCESTER (M. '95) one of the country's foremost engineers in the design of steel structures and foundations, died at Waltham, Mass., on May 9, 1943. Mr. Worcester, who was 83, was elected an Honorary Member of the Society in 1937. A more detailed write-up of his career appears in the Society Affairs department of this issue.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From April 10 to May 9, 1943, Inclusive

ADDITIONS TO MEMBERSHIP

ADAMS, WILLIAM DOUGLAS (Jun. '43), Asst. Engr., Office Eng. Div., The Panama Canal, Balboa Heights, Canal Zone.

ALLEN, SIDNEY (Jun. '43), Junior Engr. (Civ.), U.S. Engr. Dept., 11th St. (Res., 903 Augusta St.), Sault Ste Marie, Mich.

ANDERSON, CHARLES ROBERT (Jun. '43), 1st Lt., U.S. Army, 100 Bay 8th St., Brooklyn, N.Y.

ANDERSON, JAMES STUART (Assoc. M. '43), Chf. Engr., Minder Constr. Corp., 228 North La Salle St., Chicago (Res., 2433 Marcy Ave., Evanston), Ill.

BALL, RICHARD THOMAS (Jun. '43), 2d Lt., Field Artillery, U.S. Army, 804 Shawnee Ave., Lafayette, Ind.

BERMAN, MORTON JACK (Jun. '42), Stress Analyst, Curtiss-Wright Corp., Plant 2 (Res., 751 Delaware Ave.), Buffalo, N.Y.

BERNHARDT, CARL JOSEPH (Assoc. M. '43), Dist. San. Engr., State Dept. of Health, 601 Hotel Jamestown Bldg., Jamestown, N.Y.

BOGAN, BERNARD ROBERT (Jun. '43), Engr., Kaiser Cargo, Inc., Yard 4, Richmond (Res., 2470 West St., Berkeley), Calif.

BOND, IKE BERT (Jun. '42), 715 Louisiana St., Vallejo, Calif.

BRIGGS, HOWARD FANSLER (Assoc. M. '43), Dist. Office Engr., Dist. VI, State Div. of Highways, Box 1352 (Res., 533 Brown Ave.), Fresno, Calif.

BROOKS, GREGORY EDWARD (Jun. '42), Ensign, U.S.N.R., 561 Fourth St., Brooklyn, N.Y.

BROWN, ALEC TAYLOR (M. '43), Lt. Comdr., CEC, U.S.N.R., 79th Constr. Battalion, Care, Fleet Post Office, San Francisco, Calif.

BROWN, THOMAS GORDON (Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, 829th Battalion, 923d Engr. Aviation Regiment, Eglin Field, Fla.

BUIE, GLENN SMITH (Assoc. M. '43), Public Works Officer, U.S. Naval Supply Depot, Napoleon Ave. and River, New Orleans, La.

BURLESON, ROBERT BYRD (Assoc. M. '43), Res. Engr., State Highway Dept., Box 757, Gadsden, Ala.

BUSHEE, RALPH JOHN (M. '43), San. Engr., Greeley & Hansen, 6 North Michigan Ave., Chicago (Res., 220 South Ardmore Ave., Villa Park), Ill.

CASSADY, EARL WHITTON (Assoc. M. '43), Engr. of Special Assignment, State Highway Comm., Indianapolis (Res., 4109 Fairfield, Fort Wayne), Ind.

CHUN, EDMUND HINYIN (Assoc. M. '43), Associate Engr. (Structural), U.S. Engrs., 1709 Jackson St., Omaha, Nebr.

CLARK, JOHN FRANKLIN, JR. (Jun. '42), Junior Structural Engr., TVA (Res., 907 Mountcastle St.), Knoxville, Tenn.

COLE, CHESTER HENRY (Jun. '42), Junior Civ. Engr., TVA, Manning, S.C.

COOK, HAROLD ELMER (Jun. '43), Private, Corps of Engrs., U.S. Army, 8023 South Elizabeth St., Chicago, Ill.

CORSI, LOUIS (Jun. '42), 1st Lt., Corps. of Engrs., U.S. Army, Company B, 61st Engr., Battalion (C), CT 144-2 G, Brunswick, Ga.

CROWE, JOHN WERNERT, JR. (Jun. '42), 2d Lt., Air Corps, U.S. Army, 201 Ernestine St., Orlando, Fla.

CUNNING, JOHN JOHN (Assoc. M. '43), Technical Analyst, Goodyear Aircraft (Res., 1174 Riverside Drive), Akron, Ohio.

CUTLER, MYRTON HARRIS (M. '43), Structural Engr., Stone & Webster Eng. Corp., 49 Federal St., Boston, Mass.

DEAKMAN, HOMER WARD (Assoc. M. '20), Executive Vice-Pres., Deakman-Wells Co., Inc., 921 Bergen Ave., Jersey City, (Res., 46 Marcotte Lane, Tenafly), N.J.

DEBARDELEBEN, LEWIS TYUS (Assoc. M. '43), Associate Engr. (Civ.), U.S. Engrs., Dist. Office, Mobile (Res., Fairhope), Ala.

DENNY, IRVIN VINCENT (Jun. '42), Ensign, CEC-V (S), U.S.N.R., 750 Vassar Ave., Fresno, Calif.

GARBER, PAUL JACKSON (Assoc. M. '43), Specifications Engr., P 4, Engr. (Civ.), U.S. Engr. Dist. Office, 1709 Jackson St. (Res., 906 South 58th St.), Omaha, Nebr.

GILDER, JACK (Jun. '43), Asst. Engr. (Civ.), Chf., Reports and Statistical Section, Control Div., U.S. Army Engrs., Central Bldg. (Res., 313 Seventeenth Ave., North), Seattle, Wash.

GUNDERSON, LYNN HENRY (Jun. '43), Structural Engr., Portland Cement Assn., 916 Northwestern Bank Bldg., Minneapolis (Res., 881 South Cleveland Ave., St. Paul), Minn.

HANTS, RALPH LELAND (Jun. '43), Teaching Asst. Univ. of California (Res., 2625 Hearst), Berkeley, Calif.

HAYNER, JOHN LEWIS (M. '43), Pres., Fort Wayne Structural Steel Co., 4920 North Clinton St., Fort Wayne, Ind.

HAYNES, KENNETH FREDERICK (Jun. '42), Lt. (jg), U.S.N.R., 141 Monument St., Groton, Conn.

HENDRICKSON, ELLWOOD ROBERT, III (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 675 East Market St., York, Pa.

HORNEY, WILLIAM JOHNSTON, JR. (Assoc. M. '43), Structural Engr. and Draftsman, Carolina Steel & Iron Co., Greensboro, N.C.

HUBBARD, DAVID FOSTER, JR. (Jun. '42), Care, Battery D, 41st Coast Artillery, U.S. Army, Army Post Office 968, Care, Postmaster, San Francisco, Calif.

INGRAHAM, MARK WHITMORE, JR. (Jun. '42), Rockport, Me.

JOHNSON, KNUTE HAROLD (Jun. '42), Corporal, U.S. Army, Care, B Battery, A.A.S., Camp Davis, N.C.

JOHNSON, LYLE JEROME (Jun. '42), Project Lead Man, Weight Control Section, Curtiss-Wright Corp., Cheektowaga (Res., 124 Carmel Rd., Buffalo), N.Y.

JONES, ROBERT TAYLOR (Jun. '43), Ensign, U.S.N.R., 32 Harwood Ave., White Plains, N.Y.

JONES, RUDOLPH (Assoc. M. '43), Lt., CEC, U.S.N.R., 526 Westmoreland, Jackson, Tenn.

KERR, JOHN NEAL (Jun. '42), Stress Analyst, North Am. Aviation, Inc., Inglewood (Res., 4146 South Bronson Ave., Los Angeles), Calif.

KILLAM, PAUL DICKSON (Jun. '43), With Air Force, U.S. Army, 19 West Ave., Salem, Mass.

KINDELSPIRE, WAYNE GEORGE (Jun. '42), Engr., Curtiss-Wright Corp. (Res., 1150 Jackson St.), St. Charles, Mo.

KIRK, KARL QUILL (Assoc. M. '43), Estimator-Engr.-Designer, Mark K. Wilson Co., 406 Loveman Bldg. (Res., 520 McCallie Ave.), Chattanooga, Tenn.

KITCHEN, JOHN EVANS (Assoc. M. '43), Senior Engr. (Civ.), U.S. Engrs., 1209 Eighth St. (Res., 616 Twenty-First St.), Sacramento, Calif.

KLEMA, ROY LESTER (Jun. '43), Instr., Civ. Eng., Univ. of Idaho, Moscow, Idaho.

KUHNLEIN, ROBERT FRANCIS (Jun. '43), Constr. Engr., Sheffield Steel Corp., Sheffield Station, Kansas City, Mo.

LAMBERTON, HORACE CHRISTOPHER, JR. (Jun. '43), 230 Beverly Rd., Mount Lebanon, Pa.

LASSEN, PHILLIP VOORHEES (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 1130 South East 73d Ave., Portland, Ore.

LOVING, HARRY WALLACE (M. '43), Member, Constr. Contract Board, Chf. Price Adjustment Section, Office of Chf. of Engrs., War Dept., New War Dept. Bldg. (Res., 4000 Cathedral Ave., Apt. 435-B), Washington, D.C.

MCCLAIN, JOHN FRANKLIN, JR. (Jun. '42), Ensign, E-V (S), U.S.N.R., 777 B Ave., Coronado, Calif.

MADDOX, ROBERT LOGAN, JR. (Jun. '42), Ensign, U.S.N.R., Aztec, N.Mex.

MANEY, JOSEPH THOMAS (Jun. '43), 12203 Clifton Blvd., Apt. 43, Lakewood, Ohio.

MARCIN, BENJAMIN GEORGE (Jun. '43), 1638 West 2d St., Brooklyn, N.Y.

MARK, WILLIAM (Jun. '42), 821 Kelly Ave., Akron, Ohio.

MARKS, HAROLD (Jun. '42), Junior Engr. (Civ.), U.S. Engr. Office, Fort Norfolk (Res., 1520 Ashland Circle, Norfolk), Va.

MORISON, WILLIAM HOWARD (Jun. '42), Lt., U.S. Army, 7101 Colonial Rd., Apt. R 6 G, Brooklyn, N.Y.

MUSHAM, WILLIAM CHARLES (Jun. '43), Capt., Corps of Engrs., U.S. Army, Army Post Office, 722, Care, Postmaster, Seattle, Wash.

MYERS, NORMAN EUGENE (Jun. '43), With U.S.N., South Foote St., Cambridge City, Ind.

OSPINA, CARLOS SEBASTIAN (Jun. '43), Junior Engr., Eng. Dept., The Permanente Metals Corp., Shipyard 2, Box 1072, Richmond (Res., 1876 Arch St., Berkeley), Calif.

PEDRETTI, JUAN PABLO (Jun. '42), 606 East 23d St., Apt. D, Austin, Tex.

PERSON, BURTON RODNEY (Jun. '42), Lt. (jg), U.S.N.R., 102 Hawthorne, Malden, Mass.

POLLOCK, WILLIAM LEE (Jun. '42), Ensign, E-V (G), U.S.N.R., USS R - 11, Care, Fleet Postmaster, New York, N.Y.

REYNOLDS, XEN VESTAL (Assoc. M. '43), Asst. Hull Supt., Pacific Bridge Co., Yard 2, Alameda (Res., 2562 Lilac St., Oakland), Calif.

RHOADS, RUSSELL ROBERT (Jun. '42), Ensign, CEC, U.S.N.R., Box 333, Laramie, Wyo.

RYAN, ROBERT LAURENCE (Assoc. M. '42), Lt., CEC, U.S.N.R., Route 1, Box 304A, Santa Paula, Calif.

RYDLAND, ANTON NELSON (Assoc. M. '43), Associate Structural Engr., TVA, 300 Arnstein Bldg., Knoxville, Tenn.

SCHAIBLE, GORMAN FRANKLIN (Jun. '42), Cost Engr., Consolidated Eng. Co., 20 East Franklin St. (Res., 3317 Gwynns Falls Parkway), Baltimore, Md.

SCHMIDT, MILTON OTTO (Assoc. M. '43), Instr., Civ. Eng., Carnegie Inst. of Technology, Schenley Park, Pittsburgh, Pa.

SCHNEIDER, HARRY HERBERT (Assoc. M. '43), Engr. (Reinforced Concrete), Bethlehem Steel Corp., Main Office Bldg., Sparrows Point (Res., 4503 Harcourt Rd., Baltimore), Md.

SCHROYER, GEORGE BARTLEY, JR. (Jun. '43), Junior Plant Engr., Am. Car and Foundry, Arch St. (Res., 615 Broadway), Milton, Pa.

SCHUTTE, WILSON WALTER (Jun. '43), Ensign U.S.N.R., 4075 Mera St., Oakland, Calif.

SCHWARTZ, THEODORE (Jun. '42), Material Engr., Kaiser Cargo, Inc., Shipyard 4, Richmond (Res., Smartville), Calif.

SHIMER, ROY (Jun. '42), Lt., Corps of Engrs., U.S. Army, 42d Engr. Regiment (G.S.), Company F, Army Post Office 948, Care, Postmaster, Seattle, Wash.

SMITH, ARTHUR MARTIN (Jun. '42), Ensign, U.S.N.R., Box 67, Hueytown, Ala.

SOUTHWORTH, EDWIN WARREN (M. '43), Lt. Comdr., CEC-V (S), U.S.N.R., 4255 Lennox Drive, Coconut Grove, Fla.

SPROUT, DEANE ORLAND (Jun. '42), 1st Lt., Field Artillery, U.S. Army, A-26-6, FARTC, Fort Sill, Okla.

STEWART, GEORGE EDWARD (Assoc. M. '42), Maj. Corps. of Engrs., U.S. Army, Engr. Section, A.S.C., AAFSAT, Orlando, Fla.

STEWART, THOMAS MARION (Jun. '42), Junior Civ. Engr., TVA, Fort Loudoun Dam (Res., 406 Kingston St.), Lenoir City, Tenn.

TEMPLE, LAVERN ORVIL (Jun. '42), Ensign, E-B (G), U.S.N., (*U.S.S. Gilmer*), Care, Fleet Post Office, San Francisco, Calif.

THURNER, GEORGE (Assoc. M. '43), Section Engr., Associate Civ. Engr., Corps of Engrs., War Dept., Badger Ordnance Works, Baraboo (Res., 521 Washington Ave., Wisconsin Dells), Wis.

TONGUE, GEORGE FREDERICK (M. '43), Supt., Ways and Structures, Dallas Ry. & Terminal Co., 206 Interurban Bldg., Dallas, Tex.

TULLEY, PATRICK EUGENE (Assoc. M. '43), 1st Lt., Corps of Engrs., U.S. Army, 5242 Magnolia St., Riverside, Calif.

WAGNER, CLARENCE OSCAR (Assoc. M. '43), Asst. Superv. Engr., Anglin-Norcross, Care, Polymer Corp. (Res., 118½ Euphemia St.), Sarina, Ont., Canada.

WALKER, CHARLES LEROY (Jun. '42), Lt., U.S. Army, 901 West Crawford, Denison, Tex.

WATSON JOE OWEN (Jun. '43), Asst. Engr., New York Central R.R., Big Four Depot (Res., 72 East College St.), Springfield, Ohio.

WATTINGER, RALPH HENRY (Assoc. M. '43), Gen. Supt., Const., Grannis-Higgins-Thompson Street Co., Charlotte, N.C.

WEISS, HAROLD (Jun. '42), Area Engr., U.S. Public Health Service, Box 148, Thomasville, Ga.

WELISCH, DAVID ALAN (Jun. '43), Care, Naval Reserve Midshipman's School, U.S.N.R., U.S. Naval Academy, Annapolis, Md.

YODER, WARREN GEORGE (Jun. '43), Junior Stress Analyst, Consolidated Aircraft Corp. (Res., 4133 Pershing), Fort Worth, Tex.

MEMBERSHIP TRANSFERS

BAILLIE, DAVID GEMMELL, JR. (Assoc. M. '36; M. '43), Asst. to Chf. Engr., New York City Tunnel Authority, 200 Madison Ave., New York (Res., 191 Hawthorne St., Brooklyn), N.Y.

BATES, FRANCIS, JR. (Jun. '35; Assoc. M. '43), Aeronautical Engr., Vega Aircraft Corp., Burbank (Res., 1257 Burnside Ave., Los Angeles), Calif.

CAMPBELL, RAY ANDERSON (Jun. '34; Assoc. M. '43), City Engr. and Supt. of Public Works, City Hall (Res., 701 South 17th), Laramie, Wyo.

CRANDALL, HOWARD LAWRENCE (Assoc. M. '29; M. '43), Structural Engr., Crout, Snyder & Crandall, 20 East Lexington St., Baltimore (Res., 3235 Magnolia Ave., Halethorpe P.O., Baltimore County), Md.

TOTAL MEMBERSHIP AS OF MAY 10, 1943

Members	5,896
Associate Members	7,184
Corporate Members	13,080
Honorary Members	35
Juniors	5,563
Affiliates	71
Fellows	1
Total	18,750
(Total May 9, 1942	17,718)

DUVALL, ARNDT JOHN (Jun. '26; Assoc. M. '32; M. '43), San Engr., Toltz, King & Day, Inc., 1509 Pioneer Bldg. (Res., 1391 Fairmount Ave.), St. Paul, Minn.

HEWES, FREDERICK ROY (Assoc. M. '26; M. '43), Capt., CEC, U.S.N., 1815 North Hartford St., Arlington, Va.

HOROWITZ, FERMOND CECIL (Jun. '37; Assoc. M. '43), Ensign, U.S.N.R., Constr. Battalion Maintenance Unit 504, Care, Fleet Post Office San Francisco, Calif.

HUNT, OLIVER PARKS (Jun. '32; Assoc. M. '43), Draftsman, W. S. Lozier, Inc., Letterkenny Ordnance Depot, Chambersburg, Pa. (Res., 8 Hudson Ave., Green Island, N.Y.)

JEWETT, JOHN QUINCY (Jun. '26; Assoc. M. '29; M. '43), Cons. Engr., Leeds, Hill, Barnard & Jewett, 601 West 5th St., Suite 1000, Los Angeles, Calif.

KENNEDY, RICHARD ROBERTS (Jun. '35; Assoc. M. '43), Associate Engr., Clyde C. Kennedy, 604 Mission St., San Francisco, Calif.

LYLE, LAWRENCE HENRY (Jun. '37; Assoc. M. '43), Ensign, CEC-V (S), U.S.N.R., Officers Training School, Platoon 57, Camp Peary, Va.

MAGUIRE, MICHAEL (Assoc. M. '31; M. '42), Chf. Engr., Turf Development Board, 21 Fitz-William Sq., Dublin, Eire.

MEENAN, JAMES GALLAGHER (Jun. '37; Assoc. M. '43), Service Engr., United Eng. & Foundry Co., 1st National Bank Bldg. (Res., 1132 Jancey St.), Pittsburgh, Pa.

MENEFEE, JAMES HENDRIX (Jun. '36; Assoc. M. '43), 1st Lt., San. Corps, U.S. Army, 1206 Lee St., Jefferson City, Mo.

MORTON, JOHN ORDWAY (Assoc. M. '38; M. '43), Constr. Engr., State Highway Dept., State House Annex, Concord, N.H.

OWEN, WILLIAM HENRY (Assoc. M. '36; M. '43), Senior Engr. Asst. to Head, Field Eng. and Building Inspection Dept., William S. Lozier, Inc.-Broderick & Gordon, Sunflower Ordnance Works, Eudora, Kans.

PALMER, AUBREY EDWIN (Jun. '36; Assoc. M. '43), Structural Designer, Atmospheric Nitrogen Corp., Hopewell, Va.

PREST, KENNETH WALLACE (Jun. '28; Assoc. M. '39; M. '43), Capt., Corps of Engrs., U.S. Army, 1005 Grand Central Ave., Tampa, Fla.

QUINN, IRVING (Jun. '39; Assoc. M. '43), Structural Designer, J. Gordon Turnbull, Inc., 2630 Chester Ave. (Res., 11902 Buckingham Ave.), Cleveland, Ohio.

ROBICHAU, HAROLD VINCENT (Jun. '26; Assoc. M. '36; M. '43), Engr., Structural Div., Stone & Webster Eng. Corp., 49 Federal St., Boston, Mass.

ROGERS, FRANKLYN CHRISTOPHER (Jun. '36; Assoc. M. '42), Structural Field Engr., Portland Cement Assn., 347 Madison Ave., New York, N.Y. (Res., Columbus Ave., Harrington Park, N.J.)

SAWYER, ROBERT KENNETH (Jun. '37; Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, Asst. Post Engr., Post Engr. Office, Camp McCoy, Wis.

SCHULZ, WALTER GEORGE (Jun. '35; Assoc. M. '43), Lt. (jg), CEC, U.S.N.R., 2324 Twenty-Seventh St., Sacramento, Calif.

SHILTS, WALTER LEONARD (Assoc. M. '40; M. '43), Head, Dept. of Civ. Eng., Univ. of Notre Dame, Box 1413, Notre Dame, Ind.

SPENCE, THOMAS REESE (Assoc. M. '38; M. '43), Vice-Director, Eng. Experiment Station, Agr. and Mech. College of Texas, College Station, Tex.

STEVENS, ELMER BRADFORD (Assoc. M. '40; M. '42), Senior Structural Engr., The Panama Canal, Balboa Heights, Canal Zone.

SYMNS, SAMUEL YOUNG (Jun. '31; Assoc. M. '37; M. '43), Senior Civ. Engr., Wilbur Watson Associates, 4614 Prospect, Cleveland (Res., 2335 Eleventh St., Cuyahoga Falls), Ohio.

WILBURN, JOSEPH GUSTAVUS (Assoc. M. '31; M. '43), Office Engr., Fraser, Brace Eng. Co., Inc., Meadville, Pa.

WILLIAMS, NED (Assoc. M. '30; M. '43), Capt., Corps of Engrs., U.S. Army, Army Post Office 722, Care, Postmaster, Seattle, Wash.

RESIGNATIONS

CLOTTS, HERBERT VANE, M., resigned April 13, 1943.

JIVRAJANI, PRABHUDAS RANCHHODDAS, Assoc. M., resigned April 30, 1943.

MIDDLETON, ROBERT ALFRED, Jun., resigned April 30, 1943.

oc. M. '22;
Day, Inc.,
Fairmount

3; M. '43),
artford St.,

37; Assoc.
Battalion
Post Office

c. M. '43),
etterkenny
Pa. (Res.,

oc. M. '28;
Barnard &
1000, Los

35; Assoc.
Kennedy,
f.

Assoc. M.
., Officers
mp Peary,

M. '42),
d, 21 Fitz-

7; Assoc.
k Foundry
Res., 1132

6; Assoc.
S. Army,

3; M. '43),
ept., State

; M. '43),
Eng. and
S. Lozier,
Ordnance

Assoc. M.
eric Nitro-

Assoc. M.
ngrs., U.S.
ampa, Fla.

43), Struc-
Inc., 2630
am Ave.),

6; Assoc.
Div., Stone
t., Boston,

Jun. '36;
Mgr., Port-
Ave., New
Harrington

Assoc. M.
rmy, Asst.
p McCoy,

Assoc. M.
Twenty-

M. '40;
, Univ. of
Ind.

'38; M.
nt Station,
, College

M. '40;
e Panama

Assoc. M.
ur Watson
nd (Res.,
Ohio.

M. '21;
Eng. Co.,

43), Capt.,
Post Office
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April 13,

s, Assoc.

resigned